

caution-timorument

OR

A CONSIDERATION

OF

M^r HOBBS'S his
DIALOGUES

In An

EPISTOLARY DISCOURSE,

Addressed,

To the Honourable

ROBERT BOYLE, ESQ.

N^o 1. of the
of the

R. D.

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HOBBIUS

Heauton-timorumenos.

OR

A Consideration of M^r *HOBBS*
his Dialogues.

In an Epistolary Discourse, Addressed
To the Honourable

ROBERT BOYLE, Esq;

S I R,



Was told a while since, that Mr. *Hobs* had written a Book against You, for being acquainted with D. W. and me. And, upon view of it, I find that he hath done me the favour, to joyn me therein with so Honourable a person, by writing against us both. But, as (I presume) you doe not fear to Suffer much by that *Opposition*; so neither do I think

my self Oblig'd for this *Favour*: For, though the Hurt be lesse, the *Favour* is more, than was intended.

The Piece you cannot suspect to be Spurious; bearing such perfect lineaments of his Pen who is the reputed Father; and so great conformity to those others of the same brood.

—*Facies non una sororum, Nec diversa tamen.*—

The greatest difference is, that, He is much improved; (*& factus indies Obscurus*) I mean, He doth *proficere in penus*, and *expose* himself every day more than other; and more in deed than I could reasonably have expected he would have done. In so much that I cannot but profess some *Relenting Thoughts*, (though I have formerly had occasion to use him somewhat *coursely*,) to see an old man thus *fret and torment himself*, as now he doth in his old Age, to no purpose. And if you will give me leave to Apologize for your Antagonist, I think there is much to be said why You should also *pity* him. (Not as if he did Deserve it, but because he Needs it.) And, (as *Chremes* in *Terence*, of his *ταυτης τιμωριαν* *Senex*, his *Self-tormenting Menedemus*.)

—*Cum videam miserum hunc tam excruciarier,*

Miseret me ejus. Quod potero adjuvabo senem.

Indeed, if any *Danger* were like to ensue (upon this piece of *Charity* so placed) to the prejudice of any part of real *Learning*: I would not be so cruel to *Others*, as to perswade You, with their Injury, to spare Him. But since that evil is sufficiently provided for (by discoveries already made in that kind,) that the world is not, for the future, likely to be imposed upon by his Paralogisms, and *ψευδογενήματα*, (the name of *Hobbes* not bearing now any great authority with intelligent persons) it will be no dishonour for You, to *Contemn* an Enemy that cannot Hurt; or, to *give Quarter*, though he scorn to Ask it.

And, being secure of this danger: You are in the next place to consider the *Temper of the Man*, (which is one of the first considerations that I am to propose to You, to

move pity;) A person extremely *Passionate and Peevish*, and wholly *Impatient of Contradiction*. A Temper, which whether it be a greater *Fault*, or *Torment*, (to one who must so often meet with what he is so ill able to bear,) is hard to say.

And to this *Fretful Humour*, (Torment enough alone) You must adde Another, as bad, which feeds it. You are therefore next to consider him, as one highly *Opinionative and Magisterial*. *Fansiful* in his conceptions, and deeply *Enamoured with those Phantasmes*, without a Rival. He would be thought, of All that *are*, or ever *have been*, the onely *knowing Man*. And he doth not spare to professe, upon all occasions, How *incomparably* he thinks Himself to have *surpassed All*, Ancient, Modern, Schools, Academies, Persons, Societies, Philosophers, Divines, Heathens, Christians; How *Despicable* he thinks all Their writings, in comparison of His; and, What Hopes he hath, That, *by the sovereign command of some Absolute Prince*, all other *Doctrines being exploded*, his new *Dictates should be peremptorily imposed*, to be alone taught in all Schools, and Pulpits, and universally submitted to. Somewhat to this purpose you may see collected out of him, by my learned Colleague Dr. Ward, (in the first Chapter of his *Exercitation on Mr. Hobbes*. his Philosophy,) as a *Specimen* onely of what you cannot misse to meet with, in Mr. *Hobb's*, at every turn: For, to recount All which he speaks, of Himself, *Magnificently*; and, *Contemptuously*, of all Others; would fill a Volume.

'Twas a motion made by one (whom I will not name) That some idle person should read over all his Books; and, collecting together his *Arrogant*, and *Supercilious* speeches, Applauding himself, and Despising all other men; set them forth in one *Synopsis*; with this Title, *Hobbins de Se*. What a pretty piece of Pageantry this would make, I shall leave to your own thoughts: Yet am not forward to second the motion, lest the person put to this penance, should be neither *Idle*, nor *well employed*.

Nôw, where so much of *Gun-powder*, and *Tinder*, is laid in ; do but consider, how much he lies at the mercy of every man ; who, by one *Spark* of *Fire*, produced by the least Collision, may Blow him up. And think but, in what a Flame he must needs be, when he meets with others, of so much a different Opinion, from what he hath conceived of himself.

For though the admirable *Sweetnesse* of your own Nature, and *Obliging* Deportment, have not given Your Honour the *Experience* of such a Temper : yet Your *Contemplation* must have needs discern'd it, in those Symptomes which you have seen it work in others ; (like the strange Effervescence, Ebullition, Fumes, and Fetors, which you have sometime given your self the content to observe, in some active *Acrimonious* Chymical *Spirits*, upon the injection of some contrariant *Salts* ;) strangely Vexing, Fretting, and *Tormenting* it self ; while it doth but administer *Sport* to the unconcerned Spectatour. Which Temper, being so eminent in the Person we have to deal with ; Your generous Nature, which cannot but pity *Affliction*, (how much soever deserved,) must needs have some *Compassion* for him : Who besides those exquisite *Torments* wherewith he doth Afflict himself, (like that

— *quo Siculi non invenerè Tyranni*

Tormentum majus,) —

is unavoidably exposed to those two great *mischiefs* ; an Incapacity, to be *Taught*, what he doth not know ; or, to be *Advised*, when he thinks amisse : And moreover, to this *Inconvenience*, That he must never hear his *Faults*, but from his *Adversaries* ; For those who are willing to be reputed *Friends*, must either, not Advertise what they see amisse, or, Incommodè themselves.

But you will ask, What need he thus Torment himself ? What need of pitty ? If he have hopes to be admitted the sole *Dictator* in *Philosophy* ; Civil, and Natural ; in Schools,

Schools, and Pulpits ; and to be owned as the only *Magister Sententiarum* ; What would he have more !

True. *If he have.* But, What if *he have not* ? That he *had* some hopes of such an honour, he hath not been sparing to let us know : and was providing against the *Envy* that might attend it ; (*Nec Deprecabor Invidiam ; sed, Augendo, Ulciscar,* was his Resolution.) But I doubt those Hopes are at an end. He did not find (as he expected) that the *Fairies and Hobgoblins* (for such he reputes all that wrote before him) did *vanish* presently, without more ado, upon the first appearance of his *Sun-shine*. Whom though he thought, (*non Pugnando, sed*) *inferendo Diem*, to chase away ; yet he finds that (notwithstanding his new *Light*,) *certant viventes*. And (which is worse) while he was on the one side, *Guarding* himself against *Envy*, he is on the other side, unhappily *Surprised*, by a worse Enemy, called *Contempt*, and with which he is lesse able to grapple. On which account we find him now (with a *Frustra dum vivo*,) *Adjourning* his Hopes (of being *Dictator*) at least till he be *Dead*. (But what *Posterity* may do, who can tell ? For, though he be *Despised*, while he is *Alive* ; yet who knows but that, when he is *Dead*, he may be---- forgotten.)

His great *Leviathan* (wherein he placed his main strength) is now somewhat out of season : Which, upon deserting his *Royal Master* in distresse, (for he *pretends* to have been *the Kings Tutor*, though yet, from those who have most reason to know it, I can find but little ground for such a pretense,) was written in Defense of *Olivers Title* (or whoever by whatsoever means can get to be upmost;) placing the whole *Right* of Government, meerly in *Strength*; and Absolving all his Majesties Subjects from their *Alliance*, when ever he is not in a present capacity to force *Obedience*.

But (besides the *mis-adventure* of that piece) I do not find that, even while it might be thought in season, it

met with such Acceptation as he expected : Unlesse with such, as thought it a *piece of Wit* to pretend to *Atheism* ; Who would be content the rather to favour it, not for that any strength was produced to *Prove*, but because they should be now able to say, that some body durst *Affirm*, what they would be thought to *Wish*. For, one while they find him affirming, That, beside the Creation of the World, there is no *Argument* to prove a Deity : Another while, That it cannot be evinced by any *Argument*, that the World had a beginning ; and, That, whether it had or no, is to be decided not by *Argument*, but by the Magistrates Authority : And, *Fearing* upon every turn at *Immaterial Substances* : But, no where proving either the *Impossibility*, or the *Non-existence* of them.

Another Disaster there is befallen him, which doth not a little trouble him. His *New-Divinity* was to be flanker'd by his *Philosophy* : and, if any *Divines* durst to quarrel at it, they were to be shook off with this Answer, *They understood it not, for want of Philosophy* : (For he would not have it thought, that a *Divine* can be a *Philosopher*, any more than that a *Substance* can be *Incorporeal*.) His *Philosophy* is to be Releev'd by his *Mathematicks* : and therefore, if any who pretend to *Philosophy* (which some *Physicians* may be permitted to do) shall think his Proofs to come short ; his Answer's ready, *'Tis want of Geometry* that makes them think so ; and that he doth professedly *non omnibus omnia, sed aliqua Geometris solis scribere. Corp. Epist.* And lest they should think it possible to understand something without *Geometry* ; he tells them plainly, That, *whoever doth Study, Write, or Talk of Natural Philosophy, without first beginning at Geometry, they do but loose their Labour, and Abuse those who Read or Hear them. Corp. c. 6. §. 6.*

But now 'tis so unhappily fallen out, that *Geometry*, which he thought his greatest Sanctuary, hath most failed him. Nor is there any Tribe of men whatever, who are lesse satisfied in what he writes, than those who understand

Geometry. Of whom, I suppose, you have not yet heard of any one man, who is become his *Profelyte*, or will undertake to be his *Voucher in Geometry*. And doubtlesse, what ever else he is not, he is left of all found to be a *Geometrician*.

Now, Sir, 'Twould grieve a man, (if it were no more) when he hath *built* such fine *Castles* (in the Air) to see the *Foundation sink*; And his *Reputation*, which was to be mounted on the top of those *Pinnacles*, tumble with them. His *Geometry* was to have given Credit to all the rest; and is it not able to Support it self? A man *impatient of Contradiction*, is not (it's like) very well pleased with a *Disappointment*.

But this is not all. To have fallen *silently*, and *in the dark*, undiscerned; and failed of *Reputation*, but without *Reproach*; had been but a bare *Disappointment*, and losse of labour; 'twere but *lucrum cessans*, not *damnum emergens*; (And, you know, many a man there is who lives well and comfortably, with good Respect and Reputation, who hath not yet the Fame of being a *Mathematician*; And others, without pretending to *dance on the Ropes*, may *walk on the Ground* safely, without Reproach:) But, to fall *thus mounted*, where all the World are invited to be *Spectators*; and, with so much *Ostentation*, become *Ridiculous*; is an *Affliction* above the strength of such a Mortal to Bear; and may wel pretend a Right to share in that Compassion, lodged in your Noble Breast for persons in Distresse.

You'l ask perhaps, What made him, having so little, to think he had so much *Geometry*? If you will give me leave to conjecture, I think 'tis this. He had, it's like, in his younger daies gotten some small smattering in the *Mathematicks*: And, because he doth not remember, of all his Acquaintance, any who did then know more than he, that are now alive; (and it is not to be imagined, That any, who did *set out later*, should *over-run* him;) he thought he might safely conclude, Himself to be the best *Mathematician*.

matician alive. And then, what should hinder him from vaunting himself so to be?

And whereas you may suppose, That the reading of other mens Writings might disabuse him: 'Tis much otherwise. For, having once entertained that former notion, Of his own surpassing all others; He doth now professedly *study Nature, not Books*, (since that he knows already more than they can Teach; and what himself is not able to find in the Search of Nature, 'tis in vain to hope for in the Writings of men:) Or (as a great Person was pleased to phrase it) *He Thinks too much, and Converses too little*, either with Books, or Men.

And hence it comes to passe, That, Much of what he takes to be *New Discoveries*, (and thinks the World beholden for to him) are known by others to be but *Errours* long since laid aside, or *Triviall Truths*: And oft mistakes, for *New* and *more Compendious Waies*, those *Bogs* and *Precipices*, which the Experience of wiser persons had taught them to decline. Yet (for want of *Converse*, or Indisposednesse to *Improve* it,) he can as hardly be induced to think other than That he is a *Great Mathematician*; as *Heraleon* (in *Argenis*) to believe that he was not *Poliarchus*.

I forbear to mention (lest I might seem to Reproach that Age which I Reverence) the *Disadvantages* which he may sustain by his Old Age. Which though Younger persons in good manners should sometimes Dissemble, and seem not to take notice of; yet in a serious Argument, if we will *Compute* aright, they ought to be considered; And 'tis Injustice not to make allowance for them. 'Tis possible that Time and Age, in a person somewhat *Morose*, may have Riveted faster that preconceived opinion of his own Worth and Excellency beyond others. 'Tis possible also, that he may have *Forgotten* much of what once he knew. He may perhaps be sometimes more *Secure*, than *Safe*, while trusting to what he thinks a firm Foundation, his Footing failes

failes him : Nor alwaies so Vigilant or Quick-sighted, as to discern the *Incoherence* or *Inconsequence* of his own Discourses ; unwilling notwithstanding to make use of the Eyes of other men, lest he should seem thereby to disparage his o n. But certainly (though his *Will* may be as good as ever) his *Parts* are lesse Vegete and Nimble (as to *Invention* at least) then in his Younger daies.

The *Old-mans* Motto, is *ἡμεῖς ἡμεῖν, not ἑσθὺν* : Importing their Best daies to be then Past. And therefore, as to those profound Speculations, of *Squaring Circles*, *Doubling of Cubes*, &c. He should, in Prudence, have thought fit, (or, been Advised by his Friends,) either to *Attempt* sooner, or, at this Age, to *Let alone*, such Inquiries ;

— & *qua non Viribus istis*

Munera conveniunt. —

What he may have been in his Younger years, we know not : But certainly, at this Age, (though he may be willing to *Bite*, or *Nibble*,) his Teeth are too Old to *Crack Nuts*. And is it not *Pity*, that, by *weak Attempts*, at these years, he should forfeit that *little Reputation* which before he had ? and which, perhaps, if he had forborn to *Write*, he might have yet retained ? (For there are, who, *while they hold their peace*, are accounted *Wise*.)

While he had endeavoured only to raise an *Expectation*, or put the World in Hopes of what great things he had in hand, (to render all *Philosophy* as *Clear*, and *Certain*, as *Euclide's Elements* ;) If he had then *Died* ; it might perhaps have been thought by some, That the World had been deprived of a *great Philosopher* ; and Learning sustained an unvaluable Loss by the *Abortion* of *so desired a Piece* : But, since that *Partus Montis* is come to light ; and found to be no more than what little Animals have brought forth, and that, *Deformed* inough and *Unamiable* : I do not find, but that he might have taken a time sooner to go off the Stage, with more *Advantage*, than now he is like to do.

do. And tis (you know) no small Mis-fortune, for a man to *Out-live his Reputation.*

And by this time, perhaps, you may see cause to *Pity him*, while you see him *falling*. But, if you consider him *tumbling headlong*, from so great a height; 'twill make some Addition to that *Compassion*, which doth already begin to work. You are therefore next to consider, that when, upon the account of *Geometry*, he was (unsafely) mounted to that Height (of Vanity;) he did, unhappily, fall into the hands of two *Mathematicians*: who have used him so unmercifully, as would have put a person of greater *Patience*, into *Passion*: And, meeting with such a Temper, have so discomposed him, that he hath ever since *talk'd idly*. And, to augment the grief, these *Mathematicians* were both *Divines*; A sort of men whom he doth least of all Admire, and had rather have fallen by any other hand. These *Mathematical Divines* (a term which he had thought Impossible) begin to Unravel at the wrong End; and, while he thought they should have first *untild the Roof*, and by degrees gone down-ward; they strike at the *Foundation*, and make the Building tumble all at once; and that in such Confusion, that, by Dashing one Part against another, they make Each help to destroy the Whole. They first fall upon his *last Reserve*; and Rout his *Mathematicks*: (beyond a possibility of *Rallying*.) And, by *Firing his Magazine* upon the first Assault, make his own Weapons *Fight against him*. Not contented herewith, they Enter the *Breach*, and pursue the *Rout* through his Logicks, Physicks, Metaphysicks, Theology: where they find all in such Confusion, that no part answers other. They find as little sound in his *Philosophy*; (Natural, or Civil;) as in his *Mathematicks*: and, in his *Religion*, least of all. And, because he talks so much of Accurate *Method*, Legitimate *Demonstrations*, and other the like fine words, (which what they signifie with Geometricians, is understood;) they expect, that, for such *New and Daring Assertions*,

Affertions, at least, as those against the *Existence, or Possibility*, of *Incorporeal Substances*, (whether God, Angels, or the Souls of men;) against all *Obligation of Laws*, (Humane, or Divine,) further then Strength doth Enforce Obedience; against the *Authority of the Holy Scriptures*, or Word of God, further than the Magistrate gives them that Authority; That it is lawful to *Say*, or *Swear*, or *Do*, *Any thing that is commanded*, (Right or Wrong, Just or Unjust,) there being no other Rule of *Just*, or *Honest*, but the Magistrates command; But withall, that he is *no longer a Magistrate*, or hath *Right to Command*, than he hath *Strength to Compell*; and consequently, that 'tis *Lawfull*, to *Rebell* or *Disobey*, when ever we be *Able*; (with others of a like import;) He should have produced some Cogent Argument, or at least some very Plausible Reason: whereas, upon Inquiry, there is no such thing to be found; As if *Saying*, or *Jeering*, were proof enough for such petty things. And (supposing him to be of the number of those, who *ought to have a good Memory*,) as if it had been incumbent on Him, at these Years, to *Remember* at one time what he writes at Another, or, when he turns over a new leaf to remember what had been delivered in the precedent Page; they do, by Confronting places Inconsistent, make him *strike out his own Teeth*.

And, by this time, His *Bold Affertions*, without attempt of *Proof*, are found unable to stand alone: His *Slender Arguments*, where he attempts any; the woful *Inconsequence* of those things he calls *Demonstrations*; the *Inconsistence*, and *Contradiction*, of his whole Discourse; have made his whole Fabrick to fall with them;

-----*Longiꝰ perit labor irritus avi.*

I need not tell you, with what Passion he must needs receive this Affront. You may well believe that he could not without Regret see his Labour lost, his Hopes dash't, and all his Expectation of future Renown come to nothing.

'Tis true, that after this, he did, a first and a second time, (imprudently,) attempt to *Re-assert* his last *Geometry*. But with such Success, as Birds taken with Lime-twigs, the more they Flutter, the more they are entangled. And he would not have done it, had he not been as unable to understand, as to Make, a Demonstration. For *who is so stupid*, (they are his own words,) *as both to Mistake in Geometry, and also to Persist in it, when another detects his Errour to him?*

And with as little success hath he since endeavoured, when he did at length Despair of making good his *Own*, to be Revenged on *my Geometry*: And (for *my sake*) on all that durst to speak well of me. (For your Honour is not the first on whom he hath bestowed Complements upon this account.) Notwithstanding which, I am not so *unmerciful*, but that I can both pity him my self, and likewise bespeak You to the same purpose (in his own words, *Less. p. 26. 35. 49.*) That, *When you consider the opinion that men will have of him and his Geometry; When you think, how Dejected he is, and will be for the future; and, how the Grief of so much time irrecoverably lost, and the Consideration of how much his friends will be Ashamed of him, will accompany him for the rest of his life; You would have more Compassion for him, than he hath deserved. For, A man of a tender forehead, after so much Insolence, and so much Contumelious language, grounded upon Arrogance and Ignorance, would hardly indure to Out-live it. And they that have Applauded his Geometry, (I mean, if any such be; for I have not yet heard of any;) have reason by this time to doubt of all; and, if they can, to Dissemble the Opinion they had before. And lest you should think me lesse serious, while I move for Pity; I do seriously profess, that I am in earnest: For, in earnest, I pity him; and, I think also, that you have reason so to do. Especially if you consider, that (according to the Temper before described) he looks upon his own Worth, and on these Affronts, through the same*
Glasses.

Glasse; which *Magnifies* both beyond their just dimensions.

Nor doth it at all abate this ground of Pity, that what Opinion he had of his own Worth was but a Mistake: For, as on the one hand, even that Mistake deserves Pity; so, on the other hand, the Affliction is as great as if what he conceives were True. For, as to those things which do Afflict by working on the Fancy, What is *Believed*, hath the same effect as if it were *so indeed*:

—— *pariterq; pungunt*
Credita Veris.

'Tis, *To Deprive him* (he saies) *of the Honour he hath Merited*; *To Deprive him of the Friendship of all the World*; and, *No little Wickednesse*. It cannot then be but that *Heauton-timorumenos* upon these Considerations, must needs *Afflict himself* deeply, and need your Pity.

But (you'l ask perhaps) should a person, because himself is not well at ease, be therefore suffered to Rave, or Reproach all that come in his way, without Controll?

'Tis somewhat, I confesse, that is Objected. But, though I do not think a Licence of this nature Universally fit to be allowed: Yet I think there is somewhat to be said in the present case, why even this may in some measure be connived at in him. First, upon that general account, That *Loosers may have leave to speak*; For though he had not much perhaps (of Reputation) to loose: Yet he hath lost much (so far as a man may be said to loose what he never had) of what he *Hoped* for. Next, for that it doth not appear, that his *Reproaches* are very Dangerous, because not *Infective*: (like as the Bitings of some Animals, though very Angry, are not Venomous.) For *our selves*, (on whom he hath bestowed, I think, as much of that kindnesse as he doth on most,) do not find that either our Friends do *Love* us much the lesse, for his *Revilings*, or Learned Men lesse *Esteem* us. And your self, (I am confident) will as little suffer on that account as We have done.

There is yet a further Consideration, Why we are not

alwaies to take a Rigorous Account of Mens Words. But I am loth to mention it, lest you should think I grow Severe my self, while I move You to Pitty. He tells *Us* sometimes of men *lesse awake*, of *unsteddy Braines*, whom the *Speculations of Motion have made Giddy*, and of some other things (*qua dicere nolo*) which *'tis Inhumane, not to pardon, because they are not Voluntary fautes*. I shall make no other use of it, but to borrow a *Similitude*, which this puts me in mind of. 'Tis with some *Men*, as it is with some *Diseases* which affect the Brain. While the *Symptoms* do first appear, and the Distemper *begins* to work, (before the *Disease* is well discerned,) it may occasion severe Censures and sharp Rebukes, from injured By-standers, for those importune Impertinences or Provocations they meet with: But when the Distemper *works high*, and the Disease is manifest; we think those Injuries better vindicated by a Neglect, than by a serious Defense, or Reprehension. In like manner, I think, it fares with Mr *Hobs* at this day: And, that there is not *Now*, the like need of a serious Reply, to what he Writes, as when he first *Began*. For, (as *operatio lasa* doth argue a Disease, so) those Symptoms *continuing*, and *increasing*, are certain Arguments of *some special cause of Intenebration* (as he speaks) which we are not further to struggle with. And upon this Account it was, that, when he published his first Six Dialogues the last year; though fronted against my self; I did not think my self obliged to make any Reply, because 'twas known sufficiently, by what Person, and how Affected, the Dialogues were so writren; Besides, that the Contents thereof were not worth a *Book*, much lesse *Two*. Of which notwithstanding, upon this Occasion, (because it may conduce somewhat towards the Enforcement of that Motion which I am now pressing) 'twil possibly be not unseasonable to give you a (brief) Account.

And I am here first of all to take notice of a piece of
Prudence.

Prudence. He had in his former writings oft intimated what *Praises* he deserved, and how much he ought to be *Commended* for what he wrote. But finding others not so forward, as he desired, in complying with this Intimation, and perceiving that it was resented as favouring somewhat of Vanity, too *grossely* to commend himself: He found out a middle course, by way of Dialogue, between A and B, (*Thomas* and *Hobs*;) Wherein *Thomas* commends *Hobs*, and *Hobs* commends *Thomas*, and both commend *Thomas* *Hobs* as a third Person; without being guilty of self-commendation. For this reason; and, because he hath found it difficult to discourse with *others* without being Contradicted, and (so) Provoked; he might think it most convenient to *talk to himself*. Not but that he doth as oft *contradict himself* as any other, (even when he doth not sustain two persons,) but *these Contradictions* he can better bear; and, being accustomed hereunto, he may perhaps in time endure to be contradicted by others also.

These Six Dialogues (that we may know the Contents of them) are Entituled, *An Examination and Emendation of* (Modern, or) *Hodiern Mathematick*: But with this *Exegetis*, (lest his *own*, being also *Modern*, might be thought to need Emendation,) *qualis explicatur in libris Johannis Wallisii*. Which yet you are not so strictly to understand, as if it were meant only of what is delivered by my self; but, to concern those others also that have been seduced by me, (such as *Euclide*, *Aristotle*, &c. which do very frequently, and severely, fall under the lash, in this *Emendation of Hodiern Wallisian Geometry*.)

His first Dialogue (and much of the rest) is mostly spent in Carping at Words, Ranting at Symbols, and Guirding sometime at *Aristotle*, sometime at *Euclide*, or what I am not at all peculiarly concerned in; that I believe you would think my time almost as ill spent as his, if I should employ it in giving you a particular account of all those *Exceptions*, with *Answers to them*.

He is not pleased that I call that which doth directly Influence all parts of Mathematicks, and is immediatly subservient to them, by the name of *Mathesis Universalis*; because he thinks it doth not contain All Mathematicks. If I should tell him (as I may You) that *Totum Universale* and *Totum Integrale* are not wont to be taken for the same; Or that there is somewhat *Universally* common to All, beside what is *Specificall* to each Part: He would tell me (for that is one of his frequent Exceptions) that those are *Scholastick* words, not *Latine*.

He thinks it of moment also to acquaint the World (for 'tis better to do so, then not to be said to write a Book against me) That I make use of *Quamvis* or *Quantumvis*, where he thinks *Et si* would do better; (*quantumvis non sim prorsus nescius.*) That *suis* is put where he would have said *illius*; and *Instituatur*, as he thinks, for *institueret*. That I say *What comes forth in publick* (without the word *Book*) *useth to be dedicated to some or other* (without saying *Person*;) which is not Intelligible: For *whenever* Some comes without a Substantive, the word *Thing* must ALWAIES be understood. That for *prodeant* he would rather have said *prodeunt*; That *Proferre* he thinks to be a better word than *Efferre*; And *Repetendis singulis* more *Elegant* than *Repetendo Singula*. And *idem erit ac si*, is Barbarous. (with more of the same Alloy.) Which though they be some of his more choice (Mathematical) Emendations, I do not yet think so much conducing to the *Mending*, or *Marring*, of *Modern Mathematicks*; as that I need be solicitous about them: And, though I am not either Converted or Instructed by what he hath thus delivered, yet I do not think it fit to make a Book against it, lest you should think I have as little to do as he.

I shall only take occasion, to advertise You of some Elegancies; which, though You are known to be a great Master of Language, yet, I fear, you do not every where observe. You must take heed of saying at any time hereafter, that there

there be some wiser then Mr Hobs ; but rather (if You think so) that some Persons be wiser Persons than Mr Hobs. If You say, This needs not , because every one knowes what Substantive is understood ; You erre again, for You should have said every one Person knowes what substantive Word is understood. Otherwise (as Mr Hobs informs us) it will be thus supplied, some Thing is a Wiser Thing than Mr Hobs; and Every one Thing knowes what substantive Thing is understood. Again, in case at any time , in Arithmetick , you meet with this notion $0 + 0 = 0$. $0 + 1 = 1$. to be express'd in words ; take heed of saying , If to Nothing, you adde Nothing , the totall is Nothing ; but if to Nothing you Adde One, the totall is One : For (*nihilò aliquid Apponere*) To Adde to Nothing , is not Elegantly said. Nor may You say , that a Man worth Nothing, may, by good Addition to his Estate, come to be worth Something : for the Estate of him that is worth nothing , is Nothing ; and an Addition to Nothing is very improper. Neither ought You to say , *However I am not Altogether of his opinion in all things, yet &c.* But *Although*. For *However Altogether* doe not well cohere. If you say that *However* is not to be construed with *Altogether*; but, *However*, with, *I am not* ; and, *Altogether*, with, *of his Opinion* : Or, that although *However* be originally an Adverb of Comparison ; yet by use it is passed into a Conjunction Adversative (which are Barbarous words) and that it imports as much as this longer Periphrasis, *How true soever it be that I am not &c.* He tells You , No : But *However* is certainly to be construed with *Altogether*; and the sentence to be thus read , *However altogether I am not of his Opinion, yet &c.* which is not Elegant ; But if instead of *However*, you say *Although* ; it will thus run, very Elegantly, *Although altogether I am not of his opinion, &c.* Of which I do the rather advertise You; lest (in case that , notwithstanding my Motion, you shall yet think fit to say any thing to Mr. Hobs) it might be thought in you as great an Error in

Naturall Philosophy, as it is found in me an *Error in Mathematicks*, to mistake in such an Elegancy. We'l proceed.

I am then to be told ever and anon, That I am a *Presbyterian*: (Not because, he Knows 'tis *True*; but, because he thinks 'tis a *Reproach*.) But I shall be so far from *Reproaching* him for his Religion, whatever it be, that I shall not so much as *Charge him to be of any*.

He hath a double Objection concerning the Reckoning by *Ones, Tens, Hundreds, &c.* The one against the *Antiquity*, the other against the *Vniversality*, of this manner of Numbring.

He doth not think, p. 2. That the most *Ancient Records* extant, and of the most *Ancient times* (As that of *Gen. 5.* where the Ages of the first Patriarchs are recorded even as high as *Adam*) to be good evidence that Numbers were so reckoned in those *first Ages of the World*. (For who knows but that the *Pra-Adamites* might reckon at another Rate.) And against the *Vniversality* of it he objects, p. 33, that the *Welch* doe say *un ar bumtheg*, (one and fifteen) instead of *sixteen*.

For the first; he hath a conceit, That the *Bookes of Moses* might possibly not be written till the days of *Esra*; Or that the *Patriarchs* Ages are not there reckoned, as in the Times wherein they lived. Of which fantasies, when he doth produce more Authentick evidences, or more Ancient, than what we produce for the Antiquity of that Computation; 'twill be time to think of reinforcing our Argument: (As yet, there is no such occasion; nor any reason to think that *Moses* did otherwise *Record*, than they did *Reckon*.) And as for his *Welch Argument*, he knows (if he understand the language) that *un, deg, cant, mil*; are words with them of the same import, as *one, ten, an hundred, a thousand*, are with us. And his *un ar bumtheg*, proves no more against Their, then *one dozain and four*, or *two stone*, against Our reception of that Computation. For though we have occasion to reckon sometimes by *scores*, or *dozains*,

it doth not follow, That therefore we do not admit the reckoning by *Tens*, *Hundreds*, and *Thousands*. Which both They and We are known to doe.

Another Objection in matter of History, is this. (p. 2, 3.) I had said 'Tis thought, that *Mathematicks*, after the *Flood*, did flourish, first, amongst the *Chaldeans*; then, amongst the *Egyptians*. &c. Whereupon he doth (with some Majesty) call me to account, *How do I know that? Why is it so thought? What Historian ever said it? I Ought* (says Thomas) *to have Named my Author: nor is it possible to reconcile it with Diodorus Siculus*. But Hobs is a little more mild; he thinks it *credible* that I may possibly have seen it in *some Author*. And (upon condition he will excuse my fault in presuming that he might have known some Author of that opinion without my Information) I shall endeavour to make Amends for that Fault, by letting him know that *Cicero* was of that opinion (*De Divinatione, lib. I.*) who tells us that *First of all, the Assyrians*, (to begin first with the most Ancient) *having the advantage of a Large and Plain Country, and a fair Prospect of Heaven every way, did Observe and Record the Motions of the Stars, and that hereupon Astrologers, (non ex artis, sed ex gentis vocabu'o) were called Chaldeans*. And, awhile after, that the *Egyptians also, by long experience, did learn the like*. And *Pliny* in his *Natural History, (lib. 18. cap. 25.)* was of the same opinion also; recounting the four Periods of this knowledge, in this order, First the *Chaldee*, next the *Egyptian*, then the *Grecian*, and lastly the *Roman*. And *Vitruvius, (lib. 9. cap. 7.)* refers the original of this knowledge, as *Peculiar* to them; and by name to *Berosus the Chaldee*, (the most ancient that he knew of;) who upon this account (as *Pliny* tells us) had a *Statue erected, at Athens, with a Golden Tongue*. And *Berosus* himself (cited by *Josephus*) ascribes it to *Abraham*, (a *Chaldee* also.) Consonant to all which, *Josephus* (a *Jewish* writer, and as much as any acquainted with the Antiquities of his own Nation)

Amiquit. lib.1. cap.3. tells us of *Seth*, and his Posterities great skill in these Arts; and of their *two Pillars*, (erected for the perpetuating of this knowledge) whereof one was yet extant in his daies: And of their care to transmit it to their Posterity. And the like of *Noah*, (*cap.4.*) his skill in *Geometry and Astronomy*, and his care to transmit it to his Posterity. He tells us, (*cap.8.*) that *Abraham* (descended from them in a direct line) was *Eminent in this knowledge*: And (*cap.9.*) that, upon his going into *Egypt*, he did (amongst other things) *teach the Egyptians, Arithmetick and Astronomy*, of which, till then, they were wholly Ignorant. *Suidas* also (in the word *ΑΓΓΑΙ*) and *Philo Judaeus*, cited by him, do both give Testimony to the same purpose. But I forbear, as needlesse, to cite their words. (So that 'twas well guessed, that 'tis not incredible that I might have found some Author of this Opinion.) To which we may adde out of *Diodorus Siculus* (his own Author) what is said (*lib.2.*) of the *Chaldeans* skill herein excelling all mortal men; Of the Stately Temple of *Belus* erected by *Semiramis*, (about *Abrahams* time) for their *Astronomical Observations*; Of their care to transmit this knowledge from father to son in the same line; Of their Observations made and preserved for (a time to himself incredible) 473000 years before *Alexanders* time. Which incredible number of years, may be corrected by the *Chaldeans* Observations transmitted by *Calisthenes* to *Aristotle*, (upon the taking of *Babylon* by *Alexander*) for 1903 years backwards; (as *Simplicius*, out of *Porphyrus*, informs us in his Commentary on *Aristotle* 20 *De Calo.*) that is, from about 100 years after the flood, or lesse; about the time of *Pelegs Birth*: In whose daies the Earth is said to be divided, *Gen. 10. 25.* But, till then, the Family of *Noah*, (not being yet so numerous as to send out Colonies,) may very well be supposed to have taken up their habitations (not far asunder) in *Chaldea*, (and the parts adjoyning) not far from the place where the *Ark* rested.

rested, on the Mountains of *Ararat* : (And where afterwards we find *Abraham* placed; till, upon Gods command, he removed first into *Mesopotamia*, then to *Canaan*, and from thence made his journey to *Egypt*, carrying with him, as *Josephus* tells us, the knowledge of *Mathematicks*.) But that *Egypt*, a place so far off from *Armenia* where the Ark rested, should, before the birth of *Peleg*, be so well Peopled as to send out Colonies to inhabit *Chaldea*, (as Mr *Hobs* from what is said by *Diodorus Siculus*, would have us believe) is so incredible, and so unagreeing with *Holy Story*, with those aforecited, and with what *Diodorus* himself (*lib. 2.*) delivers, that it needs no other Refutation.

But the truth is, *Diodorus Siculus* (however Mr *Hobs* please to abuse his Reader) doth not himself Affirm, or Believe, what Mr *Hobs* would have Us believe from him. For see what he cites? *Chaldeos (Dicunt) qui in Babilone sunt colonos Egyptiorum, propter Astrologiam celebrari, quam à sacerdotibus Egyptiis didicerunt.* He doth not himself Affirm it; tis but *Dicunt* (the *Egyptians* do so boast;) and, if you consult the place (*lib. 1.*) this *Dicunt*, is but *fabularum*, (for so he had said but a little before;) and these fables, he tells us expressly, that he doth not believe. The summe of his Discourse is to this purpose. *The Egyptians* (he tells us) *do fabulously affirm* (though he doth not believe it to be true) that *Egypt*, being fertile of Animals, did first breed Gods, and then Men, (as, now, Mice,) and consequently was the first peopled of all the World, and all the rest of the World Colonies from them; That, about 23000 years before Alexanders time (or more) one *Hermes* found out *Mathematicks* there; And that the *Chaldeans*, one of their Colonies, did from their Priests learn that *Astrology* for which they are so famed; like as the *Jews*, another of their Colonies, did from them receive their Rite of Circumcision. Now, upon supposition that these fables be true; I grant that the *Chaldean* Astronomy must be younger than the *Egyptian*: But if not true, nor to be believed of us

Now, (which *Diodorus* could not believe Then;) to what purpose doth Mr *Hobs* produce such a Testimony? And when he tells us, (*lib. 1.*) the *Egyptians* pretend to have been Astronomers (before *Alexanders* time) for 23000 years: and the *Chaldeans* (*lib. 2.*) for 473000 years: If the pretences of each may passe for proof, which do you think must be the more Ancient? But, allowing both their pretences to be (as they are) incredible; Yet if their *Hermes* were indeed *Moses*, or *Joseph*, and *Atlas* (ancienter then he) *Abraham*, or some others at least of a like antiquity; (and, that they could not be much ancienter, the History of the Flood doth plainly enforce:) We have found already, *Astronomy in Chaldea* long before: And, to whether of the two, must we then give the precedence? But enough of this. I had said before, 'Twas Thought; and I see no reason but that we may think still, that the *Chaldean* was the more Ancient. But, what to think of Mr *Hobs*, I leave to you. I shall be briefer in the rest.

He hath a great displeasure at *Algebra* all along. He would not have it called *Analyticks*; (*Diophantus* should not have been so seduced by the *Hödiern Mathematicians*, as to give a *Greek Name* to a Thing so *Barbarous*.) He would not have it thought, p. 3. that any new Propositions have been found by it. Or, that it is a Method of Finding them out. (If any shall think so, he can confute them in two words, *Falsum est*.) Yet tells us that, in *Pappus*, there be many excellent Propositions found out by *Algebra*. He doth believe, that the Spots in the Sun, the Mountains in the Moon, the Attendants on Jupiter, the figure of Saturn, &c. were not found out by *Algebra*, (very like;) but by an Ignorant Dutch-man. This *Thomas* Thinks; and *Hobs* tells him, It is certainly so.

He doth believe (pag. 5, 6.) that *Vieta*, *Oughtred*, *Cartes*, &c. have not made any Improvement (in *Mathematicks*), none at all; That Symbols are not Shorter then Words; That Specious Arithmetick was not introduced by them; but, was constantly practised by the Ancients; ('tis not therefore to be

be condemned as *Hodiern* :) For *Words* are *Symbols*; and, the most ancient of all: That *Algebra* is a matter of *Chance*, (not of *Art*;) the *Pest* of *Geometry*, &c. In all which, *Thomas* is of the same mind with *Hobs*, and doth approve what he hath said.

He doth not think p. 3, 4, 14. that *Geometry* is lesse litigious or more certain, than *Physicks*, *Ethicks*, and *Politicks*; but These are *Mathematicks*, as much as That; and may be as clearly *Demonstrated*. (He hath shewed us, How.)

He is of opinion, pag. 7. that *Arithmetick*, being derived from *ἀριθμός*, ought not to treat of any thing but *true Numbers*, (like as *Geometry*, being derived from *γῆ*, ought not to treat of any thing but *Earth* :) That *Numbers*, are all contained in a *series*, beginning from *One*, and increasing by *One*, infinitely continued, p. 8. And 1, 2, 3, 4. &c. are *nummorum cifra*, p. 31. Yet that *One* is *no number* (because not found in that series :) but $\frac{1}{2}$ is; (because it is there to be seen, *numerus enim nullus est qui non est in progressionis huius Arithmeticae serie*, 1, 2, 3, &c. p. 97.) That there be *no numbers but Integers*; and yet that *Fractions* are *Numbers* properly so called, p. 31. But *Surd Numbers* there are none, All are *Effable*, p. 7, 8, 97. That I take the *Original* of *Number*, to be from a *Composition* of *Unites*; But it seems (saies *Thomas*) nay 'tis most certain (saies *Hobs*) that *Euclide* contrarywise takes it to be from *Division* of an *Integer*; p. 7. 11. (For *Euclide* defines *Number* to be *μὲν δὲ δυνάμει καὶ ἀριθμῷ*, a multitude of *Unites*.) But, why so Certain? Because (he tels us p. 11.) in the *Diagrams* of the first six Books of *Euclide*, *Magnitudes* are designed by *Continued Lines*, but, in the three next, *Numbers* by *Prickt-Lines*, that is *Lines cut in pieces*. 'Tis well he made use of *Clavius* his Latine Edition; for had he consulted the Greek Edition of *Euclide*, this goodly Argument had been lost; for there *Numbers* are designed by *Continued lines*, as well as other *Quantities*.) But how should we have known (had not Mr *Hobs* told us) That doth more represent a

Line cut into Six pieces, than, Six Points set in a Row?

He is not pleased p. 28. &c. that I take *One*, to be a *Number*. (Had I said, it were not; it's like he would have said; *It is*.) But why not? Because *One* is not *Many*. (True. And *Two* is but a *Few*.) But *One*, may tell, *How many*, as well as *Two*. (And if by *Number*, we mean, What answers to *How Many*: as by *Quantity*, he saies, p. 10. is meant, What answers to *How Much*: *One* is as much *Number* as *Two*.) But *Euclide*, he saies, makes *Number* to be $\mu\omicron\nu\acute{\alpha}\delta\omega\nu \pi\acute{\alpha}\nu\theta\epsilon$, and $\pi\acute{\alpha}\nu\theta\epsilon$ signifies *plura*; (Sometimes it doth: but I think *Euclide* meant it of, *What tells, How many*.) But why doth he tell us of *Euclide*? For p. 30. he would not have us so Ignorant or Absurd, as to think that it is the *Mathematicians Work*, to determine what they will call *Number*: 'Tis the *Vulgar impose Names*. (It seems, he knows well the use of a Definition.) Why did he not tell us what his *Nurse*, (as p. 61.) not what *Euclide*, calls *Number*?

Nor doth he like (p. 7, 31, 66, 98, et alibi) that I deny *Fractions*, to be (in *Euclide's* sense) *True Numbers*. (It seems 1 is not a *Number*; but $\frac{1}{2}$ is; because that is not, this is, $\mu\omicron\nu\acute{\alpha}\delta\omega\nu \pi\acute{\alpha}\nu\theta\epsilon$.) He thinks $\frac{1}{4}$ is a *True Number*, yea an *Integer*: Because *Three Quarters* is as properly a *Number* as *Three Men*; (and why not also, what he denies; $3\sqrt{2}$, that is $\sqrt{18}$: For *Three Roots*, is as much a *Number* also as *Three Men*.) True. *Three* is in each place an *Integer Number*; but *Quarters*, *Men*, *Roots*, are the *Numerates* not the *Numbers*. Yes, he says; *Homines*, is a *Number*. (True: The *Plural*. And *Homo*, the *Singular*.) But is *Homines*, $\mu\omicron\nu\acute{\alpha}\delta\omega\nu \pi\acute{\alpha}\nu\theta\epsilon$? and *Homo* $\mu\omicron\nu\acute{\alpha}\delta$? Or doth he think (for I suppose he hath heard of that distinction) that *Euclide* was talking of *Numerus Numeratus*, and not of *Numerus Numerans*?

But when all's done; Mr *Hobs* is not so Ignorant (unless he be very much So) as not to know (what ever he list to say to the contrary) that *Euclide* under the Name of *Number*, doth (very oft) comprehend a *Unit*; but not a *Fraction*.

on. If he doubt it, let him consult *Lib. 7. def. 3, 16, 21, 22. prop. 15, 24, 35. Lib. 9. prop. 3, 16, 17, 18, 19.* For in these places (and a multitude of others) if an *Unit* be not taken for a *Number*, and a *Fraction* for no *Number*; *Euclide's* propositions will agree like some of Mr *Hobs's*. Though it be as true, that, in some other places, *Unit* is contradistinguished to *Number*. For, the truth is, *Euclide*, in this, is not constant to himself; but under the word *Number* doth sometime include an *Unit*, sometimes he doth not. Like as other Mathematicians, some do, some do not, and sometimes they do, sometimes they do not. 'Twas therefore lawful, and convenient, for me, to define (saving the authority of Mr *Hobs's* Nurse) in what sense I intended to use the word *Number*, so as to include an *Unit*.

I had taken notice, that of Quantities (the peculiar Subject of Mathematicks,) there were two Sorts; *Continued*, and *Discrete*. The one saies *How Much*, the other *How Many*. That, to be *Measured*; This, to be *Numbered*. This, of *Arithmetical* consideration; That, of *Geometrical*; (and is exercised principally about *Lines*, *Superficies*, and *Solides*.) That *Time*, *Place*, *Motion*, *Weight*, &c. doth not fall under any Consideration Mathematical, other than those two; but ~~did~~ fall under this or that of them according as they were considered either capable of *Measure* (how Much,) or of *Number* (how Many.) That Geometry and Arithmetick (called *Pure Mathematicks*,) were *Sciences* properly so called, (according as the Word is used in the Schools,) That, of *Magnitude*; This, of *Number*; because there are *Subjettum*, *Principia*, & *Affectiones*, and these Affections *Demonstrated* of their Subjects. (Which, You know, are the Characters of *Science* as that word is used in the Schools: If Mr *Hobs* by *Science*, mean something else; we have nothing to do with it.) That other, whether *Arts* or *Sciences*, called *Mixt Mathematicks*, are so far *Mathematical*, as they doe contain somewhat either *Arithmetical* or *Geometrical*. What hath he to say against it?

He first saies that *I do not* (so pag. 10.) he then saies that *I do* (so pag. 11.) call *Speech, Discrete Quantity*. (One of them must needs be true; either *I do*, or *do not*.) He finds fault (p. 10.) with *Geometers* (all at once) that *Never a one had yet defined Quantity*. With the *Barbarism of Schools, even those of the Ancients*; for calling *Quanta* what he would have called *Tanta*. (But why doth he not also, elegantly, say *Tanitas*, for their *Quantitas*?) With *Euclide*, for his *unskilfull Definition of One*. p. 27. 53. With *Aristotle*, for calling *Speech, Quantity*, and, *Discrete*. p. 11, 12, 13. What *Discrete* signifies, *Thomas* doth not know, till *Hobs* informs him that it signifies *broken or cut asunder*; but that *Cutting or Breaking* it, doth not alter the *Quantity*. And he *wonders* that *Aristotle* should talk of *Quantity Discrete*. (It seems, with him, 'tis all one to say, that *Two Mice* are as *Much* as *two Mountains*; and to say, *They* are as *Many*.) He asks whether *Ration* (proportion) be a *Number*, or a *Line*, &c? Whether *Continued*, or *Discrete* quantity? (Neither. But, an *Affection* of either.) He believes that, *If Moral and Civil Doctrine had by the Ancients been Demonstrated* (as of late by *Mr Hobs*) it would have been called *Mathematicks*. He will not allow p. 15. that we are taught in *Arithmetick*, that *twice two is four*; or that it can be *Demonstrated*. Nor, that *Astronomy* teacheth us, the *Inclination of the Zodiack and Æquator*: Nor, that there can be any *Mixt Mathematicks*; (that a *Treatate* on any Subject, can handle, therein, somewhat that is *Mathematical*, and somewhat that is *hot*.)

When I give two Definitions of *Geometry* (one from the *Subject*, the other from the *End*,) he doth not like either. p. 18, 19. Not the first (*Scientia Magnitudinis quatenus mensurabilis*,) for two Reasons, first, because *Magnitudo* is not a *Proposition*, and therefore cannot be known: For *præter alienjus Dicti veritatem nihil Sciri dicitur; itaque nisi Magnum sit Propositio, sciri non potest*. Next he takes *Quatenus Mensurabilis*, to be redundant: because it is not possible,

possible, of a Magnitude, to consider any thing but this onely, That it may be measured. (You may think, perhaps, that I abuse him, in forming these Objections: But indeed I do not. The Objections are his own; and I have delivered them in their full strength.)

For, it seems, (when *Physiology* is defined *Scientia Corporis naturalis quatenus mobilis*,) that *Corpus naturale* is a Proposition: And when Geometry is by himself defined, *Scientia determinandi magnitudines*, and *Scientia per quam cognoscimus magnitudinum inter se rationes*; though *Magnitudo* be not a Proposition, yet *Determinatio magnitudinis*, and *Rationes Magnitudinis*, are Propositions, and may be Known. (But, now I remember my self, I should not have said, *It seems*; for in saying *videtur*, he saies, I do professe my Ignorance, that *I do not know whether it be so or no*.)

Nor doth the Other satisfy, where Geometry is defined *Scientia bene mensurandi*. For, (beside that *mensurandi*, is not a proposition) I should have said *Magnitudines determinandi* (as he doth p. 17.) which is not the same with *mensurandi*, (for then my definition had been good as well as his.) And yet (as we heard but now) it is not possible, of Magnitude to consider any thing but this onely, That it may be measured: Not so much as, Whether it have or have not a Being? or Existence? Whether it be *Ens*, or *Modus Entis*? Whether *Substance*, or *Accident*, or what else? Whether it have, or have not a Subject, and what that is? Whether it be Really distinct from Matter, and actually separable from it, as the Papists, or be not, as others hold? Whether it can, or cannot, be Altered; the Matter remaining the same, by Rarefaction or Condensation? (Of which he doth so often take upon him to tell me, though I do not remember that I have yet told him, What my Opinion is.) Whether Magnitude be peculiar to Bodies, or belong to Spirits also? With the like Inquiries. Which if they signifie any more than this, (Whether Magnitude may be measured?) they cannot possibly (by Mr Hobs) be Considered. Which is the Reason, why he doth so oft speak Inconsiderately. He

He is not pleased (p. 19, 20.) when I say, (and tell him, in what sense,) that *Punctum est Principium Magnitudinis*. He thinks I mean (at least he would have me,) that it is *Principium Geometriae*; but, That such Principles should be *propositions*. (As if, in Naturall Philosophy, when *Materia, Forma, & Privatio*, are said to be *tria Principia*; the meaning were, that they are *three Propositions*; and that they are *Principia Physiologiae*, not *Corporis Naturalis*: and the *Affectiões* there handled, *Motus, Calor, Color, &c.* are *affectiões Physiologiae*, not *Corporis Naturalis*.) It seems, when 'tis said, that, in *Sciences*, there are *Subiectum, Principia, & Affectiões*, he thinks 'tis intended of *Principles and Affectiões* of the *Science*, not of the *Subiect*. He may learn hereafter, that they who so speak, doe mean, *Subiectum, ejusq; Principia & Affectiões*, meaning that *Materia, Forma, & Privatio*, are *principia Corporis Naturalis*, not *Physiologiae*; and that *Motus, Calor, &c.* are *affectiões Corporis*, not *Affectiões Physiologiae*: And have been so understood hitherto, by All, but Mr. Hobs.

He is confirmed in his opinion (p. 21.) that *Punctum* is *Corpus*; because it may be *Moved*. Now Nothing can be moved but *Body*.

He doth not allow that *Extension*, or *positio partium extra partes*, is the *formalis ratio magnitudinis*, or a *Principle* from whence the *Affectiões* proceed: Because these are *Scholastick, Barbarous* words. As likewise that of *Primum quod sic*, and *Ultimum quod non*.

He allowes not (p. 22. 27) Mine, or *Aristotles*, *Definitions of Demonstration*; Nor, that some *Demonstrations* are *Ostensive*, (proving, directly, that *It is so*;) others *Deducing to an Absurdity*, (proving, the contrary to be impossible:) Or that some are *τὸ δῆλον*, (shewing *That* it is so;) others *τὸ διότι*, (shewing *Why* it is so.) But will have all to be *Offensive*, and *τὸ διότι*: For, (*Nescimus Quod res ita est, nisi sciamus, Propter quid ita est*;) It is not possible to know *That* a thing is, unlesse we know *Why*, or *How it comes* to be so. (As if it were impossible to know, *That* Mr. Hobs hath

hath made a Book, unlesse we know *Propter quid*: Or, That there is such a thing as *London Bridge*, unlesse we know, *Who* made it, and *How*.) And, That *All* good *Syllogismes* are such; For the *Assent* to the *Premises*, is the *Cause* *Why*, we *Assent* to the *Conclusion*. (As if to say, the *Cause* of the *Conclusion*, or of it's *Truth*, were the same as, the *cause* of our *Assent*: And because our *Ocular Inspection* is the *Cause* why we *Know* there is a *Bridge*, it were also the *Cause* why *There is* such a *Bridge* at *London*.)

In summe, He would have All *Science* to be *Mathematicks*; All *Quantity*, *Magnitude*; All *Syllogismes* (or number of *Syllogismes*,) *Demonstrations*; All *Demonstrations*, to be *τὸ δῖον*. Which whether it be to find fault with *Mathematicks*, or *Modern*, or *Mine*; or rather with *Logicks*, and *Ancient*, and allowed by *All* (but *Mr. Hobs*;) I leave to *Your Judgement*: and, whether it need a *Refutation*.

His second Dialogue (excepting the two first Pages; where he tells us That he doth not like some Etymologies; and, That I have skill in *Decyphering*; for which, he saith, *Thuanus* thought fit to commend *Vieta*;) is spent in *Correcting* another peice of (*Hodiern*) *Mathematicks*, called *Euclide's Elements*. The Result of which amounts to this, That *Thomas* and *Hobs* doe both agree, that *Thomas Hobs's Elements* are more accurate then *Euclide's*. There is some hopes therefore, that when *Mr Hobs* hath been dead as long as *Euclide*, his *Elements* may be in as good request: though in his *life time* (he tells us) he cannot hope to se it. But about this I shall not trouble You here. What in it may concern my self, it's like, we shall meet again. For he is not usually so sparing of his *Notions*, as to let us hear them but once.

In his Third Dialogue, I find him somewhat at a losse, for matter of discourse. He can hardly pick up in *Twenty Chapters* or more of *Mine*, so much to carp at, as will furnish discourse for One Dialogue. For besides his generall Accusations, That 'tis little worth, (in his judgment)

Judgement ;) That something might have been left out, or was known before, or some what put in that is not ; (to which, I suppose, you do not expect I should make Answer :) Or, That, (where I undertake to give account of the *Ordinary* Waies of Operation,) this is *Ordinary* ; or (where I tell what is Mr *Oughtreds* rule,) 'this is in *Oughtred* ; (which are very *True*, but no *Faults* :) 'Tis little else he hath to say, and to as little purpose. Such as this.

He desires to know , p. 57, 58. Why I distinguish Numbers thus 2, 468, 013, 579, into *Periods* of *Three* places, (according to the Computation of the *Latines*, and of Modern Nations, who reckon by *Thousands* ;) and not thus 24, 6801, 3579. into *Periods* of *four* places, according to the *Greeks* Computation, who reckon by *Myriades* ? (The Reason's plain ; Because I wrote in *Latine*, not in *Greek* : And 'tis *Hodiern Mathematicks*, not, for the daies of *Old*, that I was teaching.) And, *why I write Decimal Fractions* thus 3579, 753. like Mr *Oughtred* ? (for, I suppose he did not purposely falsify, when he left out the note of Separation to make his Reader believe I had written it 3579753.) And 'tis, because they be *Decimal Fractions*.

Then, *Thomas* cannot understand, till *Hobs* teach him, (p. 59.) That, *one quadruple quaternion, two single quaternions, and three Unites* ; or, *four times four, twice four, and three*, do make *twenty seven*. But he doth teach him moreover, p. 60. (what You and I cannot understand yet,) That *3 ad 27 sunt in proportionē 3 ad 9 duplicata*. But, *How is it possible that Analysis can be performed by Algebra* ? When *Thomas* saies, *He cannot imagine* ; *Hobs* Swears, *Nor he neither*. p. 65. (He doth not know that he who *Resolves an Equation*, doth 'Ανάλειν.)

In the mean while, he would have it believed, p. 61. That I have somewhere said, That *All the Ancients were ignorant of Algebra*. But is much pleased, that I compare a *Point* in Geometry, with a *Ciphre* in Arithmetick (as this

Then, p. 65, 66. to enform *Thomas*, what is *Analysis*, *Hobs* gives two Examples; one about *Angles*; the other about *Numbers*; and then both conclude, That there is indeed a going *forward and backward*, but what of it is *Analysis*, they do not understand. Onely this they do both underitand, That *there are not Any, Arithmetical Problems, which it is P. ssible* (for Mr *Hobs*) *to find out, without making use of Geometry*. There are Mistakes good store in the proceſs of thoſe two Examples, but I do not think meet to take particular notice of them; becauſe it's poſſible divers of them may be the Printers faults; and, becauſe I would not diſcourage any who may hope to learn from thence, What is *Analysis*.

Only p. 66. lin. 1. I do not take it to be a good conſequence, that *Because* $AA + 16A = 128$, *therefore* $16 \div AA \cdot \sqrt{128} \cdot A$. *are in continual proportion.* [Any more than I did before take it to be a truth, pag. 60, lin. 9, that the proportion of 3 to 27 is duplicate of 3 to 9. Though it be the foundation of what he calls there a *Demonſtration*. Nor pag. 67. lin. 4. that $2Q^+3R$ is equivalent to $\frac{1R^+3}{2R}$ (though he would have it thought that I had ſaid ſo as well as he;) but rather $\frac{2Q^+3R}{2R}$ æquivalent to $R^+ \frac{3}{2}$. And p. 69. l. 15 *To find a Number which, to the Number given 6, ſhall bear proportion as 4 to 5*; the Analogiſme ſhould not have been thus ordered $4 \cdot 5 :: 6 \cdot 7\frac{1}{2}$, (but thus rather $5 \cdot 4 :: 6 \cdot 4\frac{2}{3}$.) 'Tis ſond to think that $7\frac{1}{2}$ (being greater than 6) can bear to 6, the proportion of 4 to 5.

When I ſay, *To Multiply a number* (Integer or Fraction) *is to find another which ſhall be to it in a proportion given.* He asks, p. 69. *If the Number given be 6, and the proportion 4 to 5; by what muſt we multiplie the Number given? I answer; by $4\frac{2}{3}$,* (Not, as he doth, by $7\frac{1}{2}$.)

He ſaies, *I ſuppoſe the Multiplier to be Given,* (Yes; the Exponent of the Proportion.) *and, that it is the Multiplier*

of an Unite. Not alwayes. 'Tis sometimes a Fraction: As in the Case proposed.

He takes notice, p. 68. that, (amongst the operations of Integers,) I do not teach to Adde, Subduct, Multiply, and Divide *Surd Rootes*. (True. I did not think it there Proper.) This defect Mr. Hobs p. 70. &c. will undertake to supply. How good he is at this work, we may have occasion to consider hereafter. But at present, wee'l take notice of a Rule or two, to judge of his skill by.

Thomas desires, pag. 71. a solution of this Probleme. *Multiplica numerum Radicum per numerum Radicum. Exempli causa. Sint 8 Rq. numeri 9, multiplicanda in 3 Rq. numeri 4.* Which when Hobs had resolved to his full satisfaction; Thomas proceeds pag. 72. to propose further. *Manifesta hac sunt. Sed si plures radices quadraticæ, puta 6 Rad. numeri 4, ducenda sunt in plures radices, puta in 4 Radices numeri 9. Quid faciendum?* And Hobs applies himself to give a Rule for the solving of this Problem also. Now I should desire your Information, what is the Difference between *Numerus radicum* in the former Problem, and *Plures radices* in the latter. Or, (if these be the same) what then is the Difference between these two Problems. Mean while, wee'l consider another.

Divide a number of square Rootes, by a number of square Rootes. As for example, 6 Rootes of the number 36, by 2 Rootes of the number 9.

The intended $\frac{6\sqrt{36}}{2\sqrt{9}} = \frac{\sqrt{1296}}{\sqrt{36}} = \sqrt{\left(\frac{1296}{36}\right)} = \sqrt{36} = 6$ proceſſe is this,

But he thus mistakes it.

The Rule is this. Let each Number of Rootes be multiplied into that Root, and the Product be divided by the Product, (No; but, the square of the product by the square of the Product;) and the Root of the Quotient is the Quotient desired. Let's see the Application of this Rule. Since therefore 6 Rootes of the number 36, is the Root of the number 216;

(Noe; but, of the number 1296;) and 2 Rootes of the number 9, is the Root of the number 36. (True.) Multiply 216, by 6, that is, by 2 Rootes of the number 9, which makes 1296; (True, it doth so make: But what direction is there in the Rule, for this Multiplication? that the product of the Root multiplied into its number, should be multiplied into the other number of Rootes? And, had the former multiplication been true, this would have spoiled the work: but that being false, this is brought in as a botch to make amends for it:) Then dividing 1296 by 36, the Quotient is 36; whose Root is $6 = \frac{6\sqrt{36}}{2\sqrt{9}}$.

You see the Result is right; (For this he knew before hand, that 6 must be the Number sought;) But how to come at this number 6 he knew not: For having first mistaken $\sqrt{216}$ (for $\sqrt{1296}$) as equall to $6\sqrt{36}$; if he should have gone on (as his Rule, corrected, doth require) to divide 216 by 36, the Quotient would be 6, (not 36, as he expected,) and the Root of that Quotient (not 6, but) $\sqrt{6}$: which he saw was not right, (For $6\sqrt{36}$, that is 6 times 6; divided by $2\sqrt{9}$, that is 6, must needs be equall to 6.) And therefore to help the matter; seeing that not 216, but 1296, must (by 36) be divided to make the quotient 36; and finding that by multiplying 216 by $2\sqrt{9}$, that is by 6, would make it 1296; he doth, without any scruple, take that, (though his rule say nothing of any such thing:) that is, *Tinker-like* ('tis a Metaphor of his own,) he makes two holes instead of stopping one.

But let's see his Demonstration (for that he undertakes also.) *It is thus Demonstrated.* Suppose $AA = 36$; Therefore $6\sqrt{AA} = 6A$. Suppose also $9 = BB$; Therefore $2\sqrt{BB} = 2B$. And $\frac{6A}{2B} = 6$. Whether he did intend by this, to demonstrate his Rule; or to Demonstrate his Example; I will not inquire: Nor, How well he hath performed

formed either. I shall only observe, That he doth (where he thinks he can) endeavour to *Demonstrate by Symbolles*. (And therefore, That the Reason why Mr. Hobs doth not love *Symbolles*; is because the Fox did not love Grapes.) But I doe not wonder (unlesse he knew how to use them better) that he thinks *Demonstrations by Symbolles*, not to be *Per-spicious*.

Wee'l try one Rule more. Thomas asketh him, p. 73. *How is a Square Root of a non-quadrant number subtracted from another Square Root of a non-quadrant number?* And Hobs answers thus. *If those Roots be commensurable* (but how we shall know whether they be or no, he doth not tell us) *it is done*, saith he, *by this Rule. Divide each of the numbers by the greatest common measure of both.* (Perhaps he thinks, that the two Numbers having a common measure, is a sign sufficient that the Rootes are commensurable; (for he doth not intimate any other:) But that is a great mistake: for $\sqrt{9}$, and $\sqrt{15}$ are not commensurable, though 9, and 15, have a common measure. But wee'l goe on.) *Then divide the Root of the greater number, in such proportion as the Root of the Quotient hath to the Root of the Quotient.* (But when it is thus divided, which of these parts, or whether any of them, be the Remainder sought, he doth not tell us. His Example perhaps may inform us better. Let's see that.) *As for Example. Suppose $\sqrt{20}$ to be subducted from $\sqrt{45}$. Divide 45 and 20 by their greatest common measure 5: the Quotients are 9, and 4; and their Roots 3, and 2. (True.) Divide therefore $\sqrt{45}$ according to the proportion of 3 to 2, and the lesser segment will be $\sqrt{20}$.* (I doubt it. But what's next.) *and from Hence is Known, the Residue to $\sqrt{45}$.* To whom is this Residue known, by his Operation, more then it was at first? To me I am sure it is not; nor, I suppose, to You: What sayes Thomas? doth He know it? No: For he thus objects, *But for as much as $\sqrt{45}$ is not a number, it cannot be divided accurately according to the proportion of 3 to 2, (yes it may,) I desire therefore*, saith he, *to*

know, of what number, is that *Residue* a root? (He takes it for granted that an Apotome, must needs be at least the Root of a Number.) Well; But doth he satisfy this scruple of *Thomas*? Or tell him how he shall know what the Remainder is; or, of what Number it is a Root? Not a word. (Onely he tells him, that there is Another method, in *Oughtred*, which perhaps may inform him, what this Method of his cannot.)

This being all therefore that his Rule can doe, (for you have it *verbatim*), let us see what that amounts to.

And, first, (supposing the whole to be true and accurate as it is delivered, yet) it amounts but to thus much; That if from $\sqrt{45}$ you would take $\sqrt{20}$, there is in $\sqrt{45}$ a part equall to $\sqrt{20}$, which if you take away, the rest is the Remainder: Or, if from $\sqrt{45}$ you take $\sqrt{20}$, the Remainder is, $\sqrt{45}$ wanting $\sqrt{20}$. (which he might as well have said at first, without all this ceremony; and, which doth no more concern Rootes *Commensurable*, to which he pretends to fit his Rule, than those that are most of all *Incommensurable*; for even of these it is as true, That, if from One you take the Other, the Remainder is, *All but what is taken away*.) But how that Apotome, $\sqrt{45}$ wanting $\sqrt{20}$, may be at once expressed, he doth not tell us; nor, of what one number it is a Root. That it is the root of some Number, he takes for granted; (And indeed in this case it is so, but it should have been proved; For, of Apotomes properly so called, it is not true;) But he cannot tell, it seems, of what number it is a Root.

Next, it was a Mistake in *Thomas*'s Objection, (which *Hobs* ought to have Rectified,) that, $\sqrt{45}$ cannot be accurately divided according to the Rate of 3 to 2. For $\sqrt{45}$, being equall to $3\sqrt{5}$, if for the greater part be taken $\frac{2}{3}\sqrt{5}$ (or $\sqrt{\frac{21}{3}}$), and for the lesse part $\frac{1}{3}\sqrt{5}$ (or $\sqrt{\frac{5}{3}}$), it is accurately divided at the rate of 3 to 2.

But, Thirdly, 'tis as great a mistake of *Hobs* (yet *Thomas* swallows it) when he says, that, of $\sqrt{45}$ divided at the rate

rate of 3 to 2, the lesser segment is $\sqrt{20}$: whereas (beside that $\sqrt{20}$ is more than half of $\sqrt{45}$, and so cannot be the lesser segment,) the lesser segment of $\sqrt{45}$, so divided, is $\sqrt{\frac{14}{3}}$, (as was said before) not $\sqrt{20}$.

He should rather have divided $\sqrt{45}$, that is $3\sqrt{5}$, at the rate of 2 to 1. And then $\sqrt{20}$, that is $2\sqrt{5}$, being the greater segment, the Remainder $1\sqrt{5}$, would be the lesser.

I will not give You the trouble of examining more of his Rules. Onely, because (as we said) when his own Rule (which we last examined) did not succeed, he refers to another Method of Mr Oughtred, (who, from $\sqrt{147}$, subtracting $\sqrt{12}$, finds the remainder to be $\sqrt{75}$; and to $\sqrt{147}$, adding $\sqrt{12}$, the Summe to be $\sqrt{243}$.) which Mr Hobs undertakes to demonstrate for him, p. 74. I shall give you a little account of his demonstration. (That you may see how much better he is at Demonstrating a good Rule of Oughtreds, than a bad one of his own.) It begins thus. *Quod datum est sumo, radices numerorum 147 & 12 esse commensurabiles. Sunt ergo eadem radices numerorum quadratorum.* &c. Where I desire You to consider, first, Whether this be a good consequence; because $\sqrt{147}$ and $\sqrt{12}$ are commensurable, they are therefore, the Roots of Quadrate numbers; (as if no Quadratick Roots of non-quadratick Numbers could be commensurable:.) and then, Whether the thing inferred be true, that $\sqrt{147}$ & $\sqrt{12}$ be the Roots of Quadrate Numbers, that is, whether 147 and 12 (whose Roots they are) be Square Numbers. And then (if You think that a Demonstration, which begins thus, be worth further examining) You may consider another Consequence, a little after, in these words, *Ut 147 + 12 ad 49 + 4, ita est 243 ad 81. Et proinde, ut Rq 147 + Rq 12 ad Rq 49 + Rq 4, ita est Rq 243 ad Rq 81.* (Because the summe of the numbers 147 + 12, to the summe of the numbers 49 + 4, is as the number 243 to 81. Therefore as the summe of the Roots $\sqrt{147} + \sqrt{12}$, to the summe of

the Roots $\sqrt{9} + \sqrt{4}$, so is the Root $\sqrt{243}$ to the Root $\sqrt{81}$.) For if that be a good consequence, Why might he not as well inferre, *Because* $149 + 10$ is to $49 + 4$, as 243 to 81 , (for this is true) *Therefore also* $\sqrt{149} + \sqrt{10}$, to $\sqrt{49} + \sqrt{4}$, is as $\sqrt{243}$ to $\sqrt{81}$? And consequently, *Because* $147 + 12 = 149 + 10$, *Therefore* $\sqrt{147} + \sqrt{12} = \sqrt{149} + \sqrt{10}$? (Because the *summes* of the numbers be equal, *Therefore the summes of the Roots are also equal*?) And is not Mr *Oughtred*, think You, much obliged for this Demonstration? But I shall not trouble You further either with this Demonstration, or any more of Mr *Hobbs's* Rules about *Surd Roots*. A Taste is enough.

He thinks, p. 75. That *Geometria*, and *Geodasia*, are words of the same signification; (and would not have them distinguished:) For *Etymology* is a great Argument with him, in *Mathematicks*.

He takes notice pag. 76. That I had said, *Quantities compared ought to be Homogeneous*. And he allows it. But he doth not allow me to say, that *To compare Heterogeneous quantities, would be the same as to ask, How much of Time would be equal to a Line?* Because he thinks himself concerned: (as being wont to compare Time and Line:) And therefore takes some pains to perswade *Thomas*, that, If Time and Line be not *Homogeneous Quantities*, yet at least their *Quantities are Homogeneous*. And therefore he thinks fit to give notice, (and he doth it ever and anon) How Absurdly the (Hodiern) Mathematicians, do (for want of *Concrete Substantives*) make use of (the Abstracts) *Quantity*, and *Magnitude*, (as *Euclide* doth μέγεθος,) for *Concretes*. (He would have us say, *Quants* and *Greats*.)

And though You and I perhaps may think it is but a λογμαχία; and that it is not worth while to contend for words when the meaning is understood: You must take heed You say not so; For when any say thus, 'Tis, he tells us pag. 9, a certain Argument, that they do not understand what they say. And that 'tis a very great mistake, to think,

that there is any Disputation other than λογιστική, or, Any Truth other than the Truth of Words. That it is absolutely Necessary to reprehend whatever is not accuratissime dictum. That 'tis all one, non Accurate, & False dicere. (Yet of Euclide's Definition, p. 42. he saies, 'tis True, but not Accurate.) And that, De veritate rei, nisi Accuratissimis verbis constare non potest. And Thomas doth often tell us, that Hobs speaks ἀνεύθως.

Let us therefore learn (from this most Accurate Speaker) to speak Accurate, that is, (as he defines it, pag. 16.) *præsinito loqui*, that is *vocabulis uti prædefinitis*; but those Definitions, he tells us must be accurate Definitions: And to define accurately (that is, *præsinito Definire*, as we heard but now) depends on the Understanding of Words; (not, as others imagine, the Understanding of Words on the Definitions; and, that where Words are already sufficiently Understood, Definitions are needlesse; being intended by the Definer, onely to determine what he understands by those words:) And what by a Word is Every where Understood, is the Accurate signification of that Word, (For, That every Word, doth every where signifie, some one and the same thing, is not to be questioned.)

Now he doth not say, That Time and Line are Homogeneous: (for 'tis absurd to say that a Line is equal to a Time, pag. 77. though he have oft said it heretofore.) Nor that they be Quantities, (they are, he tells you, *Quanta*, but not, *Abstracte*, *Quantitas*, p. 76, 77.) But, That their Quantities are Homogeneous. And the like of Line and Weight, p. 80. That Line and Weight are Heterogeneous, is true; But yet their Quantities may be Homogeneous. What therefore is this Quantity?

To this purpose he had told us, in his Philosophy of Bodies, (cap. 12.) There be three Dimensions, Line (or Length) Superficies, and Solide; (but in cap. 8. to which he there refers, a Solid alone, one of the three, is said to have three Dimensions;) That Every of these three, if

determined, is *Quantity*: And therefore that *Quantity* cannot be otherwise defined than thus, *Dimension* determined.

But he doth not here speak Accurately; for he had not, that I find, any where prae-defined what *Dimension* is. But you may perhaps guesse at his meaning, by a Definition he now gives us of a word in the same form, (*Dial. p. 21.*) where he tells us that *Extension*, to speak Properly, is the *Action of Stretching*, and that 'tis Barbarous for the Schools to use it in another sense; (though *corp. cap. 8.* himself do so use it constantly.) And at that rate *Dimension*, must signifie the *Action of Measuring*: And *Quantity*, that is, *Determined Dimension*, must be, the *Determined Action of Measuring*. (But he is now to speak Accurately, not Properly; and so it may here signifie somewhat else than that Action.)

Again, it was not Accurate, to define *Quantitie* by *Dimension*, and restrain *Dimension* to those three, (*Line*, *Surface*, and *Solid*;). For (*Dial. p. 10.*) he affirms, *Tempus, Locum, Motum, Pondus, non minus proprie Quantitates dici, quam Linea, superficies, & Solidum*: (I would not change the construction, lest I should spoile his Latine: it is an Elegance, for *quam*, not to couple like cases:.) And therefore at what rate these Three are called *Quantities*, those Four should be so called also.

Neither was it Accurate, to call the first of those three Dimensions, *Line*, or *Length*, (as if these words were Synonymous,) for he tells us now, pag. 77. *Accurate loquentes, Lineam dicemus esse Longam, potius quam Longitudinem*. (That, is a Concrete; this, an Abstract: and therefore not *Line*, but *Length* onely, should there be called *Quantitie*; for *Quantitie* is an Abstract.) And therefore, pag. 76. we are thus taught to speak Accurately: *Omnis Quantitas (si accurate loquendum est) aut Longitudo est, aut Superficies, aut Solidum*: (Instead of *Line*, he saith *Length*: for *Line* is a Concrete, and therefore not *Quantitie*: but

but *Superficies*, and *Solide*, remain as before ; for these, it seems, are *Abstracts* :) *Tempus autem, & Motus, & Vis, ceteraq; res de quibus quæri potest Quanta sunt, Quantitates habent (quibus quanta sunt determinantur,) aliquas vel aliquam ex illis tribus, nimirum illas ipsas quibus mensurantur*: And that you may not doubt, which of the three concerns *Time* in particular ; He tells you, that, *Mensura Temporis est Linea* (for by this time *Line* is got in again, though but now thrust out to make room for *Length*.) Yet he had told us, p. 47. That, *What are Homogeneous, are measured (eodem genere mensuræ) by Homogeneous measures ; But, what are Heterogeneous (diverso genere mensuræ) by Heterogeneous measures*: And therefore, since *Time* is confessedly *Heterogeneous* to *Line*, the measure of *Time* cannot be that of *Line*.

And, he had before this time thought fit to un-say, what was said, pag. 13. *Quantitas alia est Corporum, ut Longitudo Corporis ; alia Temporis, ut Longitudo Temporis ; alia Motus, ut Velocitas & Pondus* : For now *Longitudo Temporis*, is not *alia*, but *eadem* with *Longitudo Corporis*. (The mistake was occasioned by the *Latines* distinguishing between *quam Longum*, and *quam Din* : But when he considered, that, in *English*, they do both signify *How Long* ; he was delivered from that *Error*.)

And what he had said before (pag. 11.) that *Time, Place, &c.* are *Quantitates non minus proprie dictæ, quam Magnitudo* ; is not now to take place : for though they be *Quantitates proprie dictæ*, yet they are not *Quantitates Accuratè loquendo* ; For he saies (*si accurate loquendum*) All quantity must be one of those three, *Length, Surface, or Solide*. Which doth also *Accurately* agree (or disagree) with what he had said pag. 10. *Non sunt ergo Longitudo, Superficies, & Solidum, Quantitates ipsæ, sed Quanta ;* which *Thomas* there tells him, is also *Accurate dictum*.

And by this time You understand what in *Accurate Speech* is to be called *Quantity*. *Length, Surface, and Solide,*

(to speak Accurately,) either be, or be not, Quantities. Or rather They are, and they are not, Quantities in the Abstract, every one of them.

If all this satisfie not; He tels us further, (Corp. cap. 12.) That, All men, by Quantity, do understand, that which is fitly answered to that question, concerning any thing what ever, How Much is it? As for Example, How much, or How Great is such a Length? such a Journey? such a Field? such a Bulk? Is not fitly answered by saying indefinitely, A Length, A Surface, A Solid: But, A Yard, A Mile, An Acre, A Bushel. (And in like manner, How much Time? How much Weight? An Hour, A pound. &c.) And this he tells us (Dial. p. 10.) is the Definition of Quantity: *Quantitas est per quam, querenti de qualibet re Quanta sit, apte responderetur.* I will not ask him, what is the Antecedent to *quam*? whether he mean *Quantitas est quantitas per quam*; or what other Antecedent is understood; (though he move a like question to *Euclide*, upon as little reason, p. 42.) Nor will I quetel at the word *Quanta* in the Definition of *Quantitas*; (though pag. 27. he saies 'twas unskilfully done of *Euclide* to make use of *Unum* in the Definition of *Unitas*; and condemns the Definition for naught upon that account, because it is *cognata vox*; and, an Abstract doth nothing at all confer to the understanding of its Concrete, nor the Concrete to the understanding of its Abstract: And yet, in truth, *Euclide*, had not so done, he onely made use of *in* in the Definition, not of *in omni*, but of *in omni*.) Nor will I presse to know, whether that which thus Answers the Question, (A Mile, an Acre, &c.) be *Quantitas*, and not rather *Quantum*, or, as he would chuse to speak, *Tantum*? Whether an Abstract, or a Concrete? (for hitherto the great exception hath been, that Concretes have been called *Quantity*, when as *Quantity* is an Abstract.) But we'l take the Definition for better for worse, as we find it. And now you know the Accurate signification of the word *Quantity*; and what that one thing is which it doth every where signifie.

But

But what is meant by *Homogeneous*? *Euclide* having in his Definition of $\pi\lambda\gamma\theta$, *Ratio*, (def. 3. lib. 5.) told us it was ($\mu\epsilon\tau\epsilon\theta\alpha\nu\ \delta\iota\mu\epsilon\tau\epsilon\lambda\epsilon\gamma\eta\nu\alpha\nu$) between *Homogeneous magnitudes*: That we may know what those are, he tells us (in a following Definition) that *Homogeneous Magnitudes*, or (which is all one) *magnitudes which have relation to one another*, are such as may each of them be so multiplied as to exceed the other. (For *Euclides* intent was not, as *Meibomius* mistakes him, in his *Dialogue of Proportion*, pag. 85. To enform us by that Definition, What *Homogeneous* quantities have, and what have not, *Ration* one to another; as if some had, and others had not: But To tell us what are those quantities he calls *Homogeneous*. For that by *Homogeneous* was meant such as had *Ration* one to another, was said already in the Definition of *Ration*: And what those are that have such *Ration*, he determines in that subsequent definition). And this Definition Mr. *Hobs* allows, pag. 47, to be a good Definition of *Homogeneous*. Yet pag. 77 and 80, he gives us another Definition of his own (perfectly his own, he borrowed it from no man) *Homogenea sunt quorum mensurae inapportionabiles congruunt*; (Understanding by *Measure*, as he defines it, p. 11. that, which being once or oftener taken, is coincident with the thing measured.) Informing us, thereby, that *Homogeneous* is the same with *Commensurable*. And therefore 'twas vainly done of *Euclide*, to make such ado in his tenth book, about *Incommensurable Lines*, (and 'tis no wonder therefore, that neither *Thomas* can understand, nor *Hobs* inform him, pag. 54. for what purpose *Euclide* wrot it:) For Mr. *Hobs* hath told us often, That *Linea lineis sunt Homogenea*; and, now, that *Homogenea sunt, quorum mensura congruunt*. 'Tis not possible therefore that *Lines* can be *Incommensurable*.

Being thus accurately informed, what is *Quantity*, and what is *Homogeneous*; That the *Quantities* of *Line* and *Time*, or of *Line* and *Weight*, are *Homogeneous*; he further proves by this Argument. p. 80, *Because, As the Ratio of a Line to a Line*.

Line, may be set forth by two *Lines*; so the *Ration of Time to Time*, or of *Weight to Weight*, may also be set forth by two *Lines*. (Yes, Or by two *Plaines*, or two *Solids*, or two other *Homogeneous quantities*. For *Rations* be *Homogeneous*; though one be of *Lines*, another of *Solids*, and a third of *Weights*.) But this, if it prove any thing, proves *All Quantities to be Homogeneous*. And therefore, that you may not doubt of his meaning, he tells you once for all, p. 81. *The Quantity of any thing, to the Quantity of any other thing whatsoever, is Homogeneous; And therefore the Quantities of Lines, Superficies, Solids, Time, Motion, Force, Weight, Strength, Resistance, are all Homogeneous, though themselves be Heterogeneous*. And Thomas doth here applaud him as having said *clare & accuratissime quod res est*. (And therefore of what was said accurately before, of *Three sorts of Quantities*, pag. 76. *All Quantity, to speak accurately, is either Length, or Surface, or Solide; Time, Motion, and every other Quant, having for its Quantity one of these Three; that of them by which it is measured: The two latter must be blotted out; For now there is but One sort. Surface and Solide are no longer Quantities, but Heterogeneous things. Linea linea, Superficies superficiei, Solidum solidum, Homogenea sunt; sed, altera alteris, Heterogenea*, p. 81 and cannot therefore be *Quantities*, which are, *All to All, Homogeneous*. You must now read it, *Omnis Quantitas, si accurate loquendum est, Longitudo est*.) And therefore *Euclide* doth but trifle when he restrains *Ration to Homogeneous magnitudes*, (for there are no other;) and *Defines* those *Homogeneous Magnitudes* to be such, as that *each may be so multiplied as to become greater then the other*; (for *All are Homogeneous*, and therefore may so be multiplied.) And therefore since the *Quantity of Time* (an *Hour*) is *Homogeneous to the Quantity of Line* (a *Yard*) there must some *Number of Hours* be longer then a *Yard*; and, some *Number of Yards*, longer than an *Hour*. And therefore it is not improper to ask, *How many Hours long a Yard is? Or, How many Yards*
long

long is an Hour? And (lest you might think I abuse him, by making an odious Inference,) You shall have it in his own words, p. 48. *Habent rationem inter se Mensura Longitudinis, Temporis, & Motus, & possunt multiplicata se mutuo superare.*

And yet after all this, pag. 110. he tells us that the *Quantity* of the Angle of Contact is *Heterogeneous* to the *Quantity* of a Streight-lined Angle. And that upon this ground; Because the Measure or Quantity of the one, is *Arcus circuli*; But, of the other (he saith) *linea recta*; which cannot *congruere*. (Yet heretofore he had often told us that *Linea linea*, without considering whether Streight or Crooked, is *Homogenea*: And he must not yet deny it; because he is by and by to square the Circle, and give a Streight Line equall to a Circumference.) Nor doth he affirm only that *Line to line* may be *Heterogeneous*, but also *Number to number*: for thus he tells us, *Numerus numero, si qua numerantur sunt Homogenea, Homogeneus est: alioqui, Heterogeneus*. So then, The *Quantity* of two Lines may be *Homogeneous*, or equall, to the *Quantity* of two Plains, but the *Number* of two Lines, is neither Equall, nor *Homogeneous*, to the *Number* of two *Plaines*.

I should not have detained You so long upon this Subject, but that I thought it necessary to give an Instance of what I did before intimate, How possible it is for Mr Hobs to Forget, or not Consider, at One time, what he hath written at Another. And, that you may see how extreamly *Confused* his Notions are, even where he pretends to *speak Accurately*. Yet hath he that opinion of his own *Accurate speaking*; that in one Dialogue (the first of these six, containing but 32 Pages,) he doth about 37 times (and how often in the rest, I did not think it worth the while to number) either directly *Commend himself for speaking Accurately*; or Reprehend others, as *lesse Accurate* then he; (but with various cadencies, *Accurate, Accurata, Accuratissima, Accuratus, Accuratissime, ἀκριβές, ἀκριβώς, ἀκριβεια, &c.*) besides his other Commendations of *Reflé,*

omnino, certe, certissime, exquisite, perspicue, clare, clarissime, & nihil clarius, & quod res est, &c. which up and down we meet with at every turn.

But if you ask me (as perhaps you may) How he should have spoken to speak Accurately as he pretends: I say first, he should have spoken *Consistently*, (for 'tis not at all accurate, so grossely to contradict himself.) Next, 'Tis confess'd, that a *Quantity*, and a *Magnitude*, are, as to the Grammaticall form, *Abstracts*; but, in common use, doe passe for *Concrets* (for want of Concrete Substantives:) Nor is it an *Hodiern* or Modern Innovation in Mathematicks so to speak: but Euclide and other ancient Greeks, did at the same rate use *μῆκος*, as the Latines doe *Quantitas*, and *Magnitudo*, for Concrets. And *Verba valent ut Nummi*; whatsoever they were first Coined for, they must now pass at that value, which use hath put upon them. Next, his Notion of *Quantitas in Abstracto*, is Heterogeneous to this business, being a Metaphysicall, rather than a Mathematicall consideration of it. The *modus* is not considered in Mathematicks, but the *modus*. 'Tis Metaphysicks not Mathematicks that consider *Abstract Formalities* of things. That considers the Formality; This the Measure; and 'tis not *modus*, but the *modus*, we measure. Then 'Twas farre from Accurate to thrust out *Linea* (because a Concrete) to make room for *Longitudo*; and, at the same time, to keep in *Superficies* and *Solidum*, (which are as much Concretes as *Linea*;) He should therefore, in accurate speech, have said, either *Linea*, *Superficies*, & *Solidum*, or else *Longitudo*, *Amplitudo*, & *Granditas*, (either all Abstracts, or all Concrets;) and not as now *Longitudo*, *Superficies*, & *Solidum*. Next, 'tis a very great Negligence, when he doth so much contend for Abstracts only to be called *Quantity*; to tell us, that not *Longitudo* &c. are *Quantities*, but somewhat else that answers to the Question *Quantum*; which every one knows must be a Concrete: (and such, is that he gives for instance *p. 10. tanta quanta est ulna &c.*) For, not *Quantitas*, but *Tanti* answers

answers to the Question *Quantū*. And then, 'tis very unacurate to define his *Abstract* (Metaphysicall) Quantity, *p. 10. Quantitas est per quam quarenti de qualibet re Quanta sit, apte respondetur*; (For Quantity is neither *per quam queritur*; nor *per quam respondetur*.) He should rather have said; *Quantitas est illa Entis Affectio, secundum quam, queritur Quantum est, & respondetur Tantum*; or *queritur Quam, & respondetur Tam*. And in like manner, of the severall kinds of Quantiry; as *Longitudo, Amplitudo, Granditas, Duratio, &c. est illa entis Affectio, secundū quam queritur, Quam Longum, Quam Amplum, Quam Grande, Quam Din, &c. & respondetur Tam Longum, Tam Amplum, Tam Grande, Tam Din &c.* But whether or no, *Tam Longum*, and *Tam Din*, be Homogeneous, any more then *Tam Longum*, and *Tam Amplum*, &c. I think, needs no very profound Intellect to determine. But if he leave his Metaphysicall notions, and speak of the Mathematicall *ποσόν*: Whether he mean thereby that which is *measured* or *measurable*, (and call it *Line, Surface, Solide, Time &c.* or, which will here be much the same, *Longitude, Amplitude, Grandour, Duration, &c.*) Or mean, some *determined Portion* thereof, (and call it the *Determinate Dimension, the So much*, or that *which tells How much*; as a *Yard, an Acre, an Houre, &c.*) 'Twill be either way equally Absurd; to say that a *Line is Equall, or Homogeneous to Time*; or to say that *A Yard is Equall or Homogeneous to an Hour*. But if (as sinking men are ready to catch at any thing) by *Quantity* he will mean *Proportion*: and, in saying *The Quantity of a Line is Homogeneous to the Quantity of time*, he mean, *The Proportion between two Lines, is Homogeneous to the Proportion between two Times*: He doth but trifle. For though it be true, that *Ratios or Proportions be Homogeneous*, how *Heterogeneous* soever the *Termes* of the one are to the *Termes* of the other: (And so are *Numbers* also, though the things *Numbred* be *Heterogeneous*; however Mr. Hobs tell us the contrary: For *Two Mountaines, are as many, as Two Lines*;) Yet this

is not at all to the purpose. For we are now talking of the *Quantity of a Line* (which he tells us pag. 13, is *Quantitas Absoluta*,) not the *Ration of two Lines*, (which there he tells us is *Relativa*.) But he, by confounding the *Absolute* with the *Relative*, and the *Mathematical* notion of *Quantity* with the *Metaphysical*, (and skipping confusedly from one to the other, without a distinct apprehension of either,) is so bewildred, as that he knows not which way either to go back, or forward. And all this, out of a Pertinacy to defend a former mistake, in comparing *Line* and *Time* as Homogeneous Quantities.

I must now beg your pardon for having detained You so long (for the Reason but now mentioned) about the business of *Homogeneous Quantities*: And at the same time crave leave (for the same reason) to do the like upon the business of *Ration*, which is the Subject of his Fourth Dialogue, (besides wh it is to be gathered up out of former or following Dialogues to that purpose.) And you must give me leave to use the word *Ration*, though lesse English, to avoid an Inconvenience otherwise unavoidable. For though the word *Proportion*, You may think, would do as well: Yet since that, you know, this word is used, by some, for what *Euclide* calls $\lambda\omicron\gamma\theta$, and, by others, for whar he calls $\alpha\nu\alpha\lambda\omicron\gamma\iota\alpha$; I must not use it in either sense. For if I should use it in the former sense, Mr *Hobs* (as his manner is) would be sure to take it in the latter, and dispute against it at that rate; if in the latter, he would take it in the former, and dispute accordingly: (For, that he knows of no other *Disputation* than $\lambda\omicron\gamma\theta\mu\alpha\chi\iota\alpha$, You heard but now.) Nor must I use the word *Reason*; for, That he would interpret either for *Cause*, or for *Understanding*. And yet, even thus, I am not secure. For were I writing to Mr *Hobs*, I must expect to be told that *Ration* is but a barbarous word (and nothing but *Reason* mis-spelled;) And, however, *Reason* and *Ration*, being words of the same Original, (as much as $\delta\iota\mu\alpha\delta\iota\omicron\varsigma$ and $\delta\iota\mu\alpha\delta\iota\omicron\nu$, or *double* and *duplicate*,) is

duplicate,) cannot (in Grammar) but signifie every where the same thing. And therefore *Ration* must needs be interpreted of *Understanding*. (For, that *Reason* doth, sometimes, so signifie, I cannot well deny.) But that Person of Honour to whom I am now speaking, being Intelligent at another rate, makes me secure, that I shall be neither not-understood, nor mis-interpreted.

His Fourth Dialogue, therefore, being wholly spent about the businesse of *Rations*, I shall to this place refer what I meet with in him, scatteted up and down, about that matter; that You may see with how little of Reason he manageth this whole affair.

I had said that *Homogeneous* Quantities may be compared each to other, either as to their *Difference*, or as to their *Ration* or Proportion. As 6 exceeds 3, by 3. Or, is the double of three: The former saies *Quanto plus*; the latter *Quantuplum*. But this Mr *Hobs* (p. 77, 114, &c.) cannot Understand. *Quotuplum*, he knows; but he thinks *Quantuplum* and *Tantuplum* are not *Latine*; and he knows not how to put them into *English*. (If he had known the difference between *Aliquota pars*, and *Aliquanta pars*; He might have known, that as *Quotuplum* is the Correlative to *Quota pars*; so *Quantuplum*, to *Quanta pars*. But whether it be *Latine*; or, Mr *Hobs*, know how to make it *English*, is that which I am to neglect.) The former, I said, is determined by the *Remainder* in Subduction; The latter, by the *Quotient* in Division. (And when Mr *Hobs* is in a good mood, he can say so too; as Lesson. p. 16. *As the Quotient gives us the measure of the Dividend to the Divisor in Geometrical Proportion; so the Remainder after Substraction is the measure of Proportion Arithmetical.*) Thus, if, the Antecedent being divided by the Consequent, the Quotient be *Two*; we call it *Double*; if *Three*, *Treble*; if *Four*, *Quadruple*, &c. The Proportion taking its Denomination from the Quotient. (And this also Mr *Hobs*, when he thinks fit, can allow too, as *Corp. cap. 13. §. 16. Ratio*

2. ad 1. vocatur *Dupla*; & 3. ad 1. *Tripla*: Though at another time as *Less. p. 21.* and 42. he think it Absurd and not Intelligible, to say, the *Prop. of 2, to 1;* or of 6 to 3, is *Double.*)

I had said further, that as to the former comparison, the *Difference, or Remainder, was always Homogeneous to the Quantities Compared;* (if these be Numbers; that, a Number: if these Lines; that a Line; &c.) But as to the latter the *Quotient was oft Heterogeneous;* (as being always a Number, or *Homogeneous to Number;*) For though the Quantities compared be Lines, Plaines, or the like; Yet still the Quotient *transit in genus Numerosum.* (Which what it means, because Mr. *Hobs* says he cannot understand; he may be informed that by *genus numerosum*, I mean, what is *eiusdem generis cum numero*, or, as I had said before, *Homogeneous Number.* For so all Quotients are; if not *true Numbers*, yet at least such Quantities as may be so multiplied as to exceed a Number.) And whether we ask How many times the Double Line, or the Double Number, contains the Single, the Quotient in both cases is 2. Whether Mr. *Hobs* (when he understands it) will allow this or not, I cannot tell. For though *Dial. p. 80.* he allow that *All Ratios (Geometricall) be Homogeneous*, yet *pag. 110.* he will not allow that all Numbers be so; which seems to unsay the former. For if the Number of two Yards, be not Homogeneous to the Number of two Acres; it may as well be doubted whether the Proportion 2 to 1 in Yards, be Homogeneous to the Proportion of 2 to 1 in Acres. Especially when he hath told us heretofore, *Corp. cap. 11. § 5, Consistit Ratio Antecedentis ad Consequens in Differentia, hoc est, in ea parte majoris, qua minus ab eo superatur; five in majoris (dempto minore) Residuo, non autem simpliciter; sed ut comparato cum altero relatorum: ut Ratio binarii ad quinarium est ternarius, quo quinarium binarium superat, non simpliciter sed quatenus cum binario, vel quinario comperatus.* Now if Proportion consist, as he saith, in the Remainder, or that Part of the Greater whereby it exceeds the Lesser; then the Proportion of Number to number mu

be a *Number*, (as he there tells us, the proportion of the number 5 to the number 2, is the number 3, whereby 5, exceeds 2;) and the proportion of *Line to line*, must be a *Line*, (as follows there Chap. 12. § 8. *The proportion of the unequal Lines EF, IG, consists in the difference GE, &c.* which is a *Line* :) therefore the *Proportion of number to number* (being a number) cannot be Homogeneous to the *Proportion of Line to line* (which is a *Line*,) unless that *Number* and this *Line* be Homogeneous. which whether Mr. Hobs will affirm, or not, I am not solicitous.

But Mr. Hobs being thus engaged, as you see, in making Geometrical Proportion, not only to depend on, or be estimated by, but to consist in, the *Residue*, or that part of the greater whereby it exceeds the lesser Quantity: Thinks himself obliged to reproach me, (though himself, as you heard but now, can say so when he please) for saying, that *Proportion is to be estimated by the Quotient*, and that therefore *Equall Quotients doe argue equall Proportions*. For in thus doing, he sayes, I make *Proportion*, to be a *Quotient*, a *Number*, an *absolute Quantity*. &c. (Forgetting that all the while he doth but reproach himself, who says, it consists in a part of the greater quantity, that is in a *Line*, a *Number*, a *Solide*, or whatever that *Absolute quantity* is that is compared.) No, I do not make *Proportion*, a *Quotient*, or an *absolute Quantity* (that's but his inference, and a weak one.) I say indeed that *Proportion depends upon the Quotient*, is determined by the *Quotient*, estimated by the *Quotient*, and denominated by the *Quotient*; not, that it is the *Quotient*. My words are full and clear, (had not he a mind, as his manner, is to pervert them,) *Ratio dividenda investigatur. Divisionis nempe quotiens Offendit rationem Dividui ad Divisorem.* (Sic si 12 per 6 dividantur, prodibit Quotiens 2: cui cognominis, ratio Dupla, illa est quam habet numerus 12 ad 6. Item Quadripondium est Bipondii Duplum: quia si 4 pondo, per 2 pondo dividantur, prodibit Quotiens 2: quippe toties hoc illo pondus continetur.) Et propterea, ubi Quotientes invicem

Aquantur, ibi & quantitates, in Eadem Ratione constituta intelliguntur. Quippe Ratio ex Quoto aestimatur; adeoque & ex horum aequalitate, aequalitas illarum. Cap. 25. Of which Mr. Hobs can make no other sense, but this, Proportion, is a Quotient. And when I say, Cap. 35. Nobis (qui Rationes superius docuimus Quoto aestimandas) ad Rationum sive aequalitatem sive indentitatem probandam sufficere videtur, si fuerit aequalitas sive indentitas Quotorum: Mr. Hobs (according to his wonted ingenuity) pag. 93. cites my words thus, Aequalitas sive Identitas Rationis, est Aequalitas sive Identitas Quotorum. But such Falsifications are so frequent with him (as if Hobbiana fides, were the same with Punica) that 'twere endlesse to note them all; 'Tis enough to intimate; That You are not always to take for my words, what Mr. Hobs cites as such. Whether it be therefore I, or he, that make Ratio to be an Absolute Quantity; it is not hard to judge.

And (besides that he thus makes Proportions to be Heterogeneous) when he says, *It consists in the Difference, as compared with one of the Relatives; As thus (Dial. p. 78) The difference between 4 and 2, is half the Antecedent; and the difference between 2 and 1, is half the difference, (No, but the whole difference) between the Antecedent and the Consequent: The Result will be but this, The Proportion of the Antecedent to the Consequent, consists in this, that the difference of the Antecedent and the Consequent, doth bear such a Proportion to this or that of them: (as that it is half, or a third part, or the double, &c.) which is a Ludicrous Definition. For the Proportion of the Difference to either Antecedent or Consequent, must be supposed to be as little understood, as the Proportion of the Antecedent to the Consequent; which was to be defined.*

And then whether it be more naturall to expresse the Proportion of 6 to 3, (as Mr Hobs would have us) thus; *That the Antecedent exceeds the Consequent by a Number equal to half it self, or, by a Number equal to the Consequent; And that of 9 to 3, thus; that the Antecedent exceeds the Consequent by a Number equall to two third parts of it self; or, by a Num-*

ber which is equall to the double of the Consequent, (which is the best of what Mr. Hobs his Notion can reach to :) Or to say, 6 contains 3, Twice; and 9 contains 3, Thrice. I leave to any, that is but well awake, to judge.

But I have said formerly; That *Quotients*, *Fractions*, and *Rations*, are oft designed in the same manner: And $\frac{2}{3}$ may either signifie, The *Quotient* of 2 Integers divided by 3: Or, 2 parts of One divided into 3 parts: Or, that Part of One which is in *Proportion* to the whole, as 2 to 3. And which soever of the three wayes it be understood; $\frac{2}{3}$ will signify the same quantity. But this, saith Mr. Hobs, is to make *Quotient*, *Fraction*, and *Ration*, the same thing. No, not precisely the same, but of very great *Affinity* (I suppose you will give me leave to use that word though Mr. Hobs p. 98. will not) one to another. The *Quotient*, is the Denominator or Exponent of the *Proportion*; (as 2, of the Duple; $\frac{1}{2}$, of the subduple; $\frac{1}{4}$ or $1\frac{1}{2}$, of the sesquialter. &c.) even of that proportion which the *Fraction* beares to an Integer. And if one of these be called by the name of the other; 'tis no greater fault then to put the Abstract a *Quantity*, for the Concrete a *Quant.* (Which Mr Hobs doth as frequently as other men, even when he thinks he speaks Accurately, and tells us *Less.* p. 15, 'tis common speech, as well amongst Mathematicians, as amongst common people; and though improper, cannot be altered, nor needeth to be altered, to Intelligent men; and p. 19, that all Intelligent men are contented with that expression; though He be not.) And, whether we say Two Yards (which is an Absolute quantity) or, The double of a Yard (which is a Relative;) 'tis the same thing in reality, though in formality of speech different; And the like of Half a Yard, or an Half-Yard: (This a *Fraction*; that, a *Ration*;) Which Identity of signification, under the Different formality of speech, is the meaning of that which Mr. Hobs makes so much of (as having found a great purchase) pag. 82. *Fractiones nihil aliud sunt quam Rationes.* (Which is as much as to say *Triens* is the same with *Subtriplum*; and *Dimidium*

Dimidium or *Semis*, the same with *Subduplum*; that an *Half-Yard* and *Half a Yard*, is the same.)

And he observes (pag. 82.) that I say *Duplum*, *tripulum*, &c. are taken to be Names of *Ration* (and the like of *Subduplum*, *Subtripulum*, &c. their Correlates; which, I said but now, are the same for substance with *Semis*, *Triens*, &c.) He would fain carp at it, but knows not which way to form his Objection. Somewhat he suspects there is, not Accurate; but is not himself so Accurate as to find what it is. Therefore I shall a little help him out. When I say *Duplum est Nomen Rationis*; 'tis at the same rate, that we say *Father*, is a Name of *Relation*; whereas (according to Mr. Hobs his *αριθμητικόν*, or as he doth constantly write it, *αριθμητικόν*,) not *Father*, but *Paternity*, is the *Relation*; and *Father* is but the *Relate* which hath this *Relation*. And in like manner *Duplum* is not precisely the *Ratio*, but *Rationem habens*; not the *Rate*, but the *Rated*: (*συνάριθμος* is the *Ratio*.) But for want of a *Concrete* (for had I said *Rationatum* or *Proportionatum*, he would have called it *Barbarous*) I made bold with the *Abstract*. Which had he discerned; he would doubtlesse have rebuked me as severely, as he hath done my betters, for saying a *Quantity* instead of *Quant*.

But, why may not *Duplum*, be *Ratio*? Because (he tells us pag. 13. 98.) *Ratio* is not *Quantitas Absoluta*, but *Relativa* or *Comparativa*. Well: And is not *Duplum*, *Relativum*? Is not *Duplum*, *Dimidii duplum*; and *Dimidium*, *Dupli dimidium*? Doth not himself tel us (Leff. pag. 81) that, *halfe*, and *thirds*, &c. are names of *Quantity Compared*? But, by *quantitas Relativa*, he means, *Relatio*. Very good: He should then have said, 'Tis *Relatio quantitatís*, not *Quantitas Relativa*. For *Relativa* is as much a *Concrete*, as *Duplum*. And therefore This as much a *Ration*, as That. I have detained You, I doubt, too long, in tracing Mr. Hobs while he is picking *Serames*: But being thus farre engaged, thier's one *Sirrow* more lyes in his way, wch I must remove. The *Quotient* of the *Antecedent* Divided by the *Conse-*

quent (which gives Denomination to the *Ration* or *Proportion*) what to call at present, so as to satisfy Mr. *Hobs*, I doe not well know. If I should call it the *Quantity* of the *Proportion*, as some have done: Mr. *Hobs* tells us, p. 86. *He doth not believe I ever saw any Authour who did so call it*: (it seemes he hath not.) If I call it a *Quotient*; he will tell me, *Quotient there is none but in Aliquote pars. Less. p. 20.* (Yet *Dial. p. 52.* he sayes; *If 15 be divided by 4, the Quotient is 3½.*) If I should call it the *Denominator* of the *Proportion*; he would pervert my words, and take it presently for the *Denominator* of a *Fraction*; and aske, whether of the *Denominator* be Four. I shall call it at present the *Exponent* of the *Ration*; as 2 is the *Exponent* of *Duple*; 3, of *Triple*; $1\frac{1}{2}$, of *Sesquialter* &c. (nor shall I much concern my self whether Mr. *Hobs* understand it, nor; I write to You who doe.) Now I doe sometimes (as others have done before me) to this *Exponent* give the name of *Ration*; (as *Ratio 2*, for the *Ration* of 2 to 3, or the *Ration* whose *Exponent* is $\frac{2}{3}$.) And this is that which Mr. *Hobs* can not understand. But, that I am not the first who have thus used to speak, Mr. *Hobs* will be my Compurgator: For finding that Mr. *Oughred* is wont so to speak; (in the *Latine*, as well as the *English*; though this Mr. *Hobs* would fain dissemble:) he would have it thought pag. 82. that *I translated his Clavis into English*. (Whereas, the truth is, when that Book was first made *English*, I understood as little of *Specious Arithmetick* as Mr. *Hobs* doth now: so farre was I from being the *Authour* of that *Translation*.)

But, (if it were worth while) I could mince words as finely as Mr. *Hobs*, and split a *Haire* as nicely as he. And tell him, that even what we commonly call the *Quotient* in *Division*; is capable of more formalities than one, according as we suppose the *Question* to be variously put. For example. Because 2) 6 (3. That is, if 2 divide 6, the *Quotient* is 3. If the question be put, according to *Euclide's* style By what Number doth the Number 2 divide the Number 6; or,

2 pound

2 pound, divide 6 pound; (which is as much as, what Number Multiplied into 2 pound, will produce 6 pound;) the Quotient will be *Three*, (a number *Cardinall*.) But if we put it (as usually we doe; and from whence Quotient takes its name) Quoties, or How often, is 2 contained in 6, (or 2 pound in 6 pound;) the Quotient is *Twice*, (a numerall *Adverb*.) But if we put it thus, Quota pars is 2 of 6: the Answer is *Tertia*; the part denominated by 3; (and hence the Quotient is called as well *Numerus Quotus*.) But if thus, Quotuplum is 6 of 3. The Answer is *Triplum*. So that 3 may be interpreted (according to the severall notions in which we conceive division) to signify, *Tria*, *Ter*, *Tertia*, or *Triplum*; which you please. Though usually we take it to be a *Cardinall number* (from whence the rest are denominated) or what is Homogeneous to it; which multiplied into the *Divisor*, doth produce the *Dividend*. And if so taken, The *Fraction* (proper, or improper) is *Ratio in Concreto*: The Quotient, is *Denominator Rationis*, or *Exponens Rationis*, or *Quantitas Rationis*, (for that 'tis so called, we shall hear anon:) And the *Relation*, is properly *Ratio in abstracto*. Thus because 5 divides 10 by 2; *Duplum* (the Double) is *Ratio in concreto*: *Similiter* (the Doublenesse) *Ratio in abstracto*: And *Duo* (the Quotient, or number *Two*) is *Rationis Exponens*. So (if 10 divide 5, by $\frac{1}{2}$;) the like is to be said of *Dimidium* (the Half;) *Medietas* (the Halenesse;) *semis* *propter* (Half One.) But enough of this. If Mr. *Hobs* can distinguish more accurately, I shall be willing to learn.

I shall trouble you but with one word more about the name *Ration*. These Numbers (or Quantities proportionall to them) 1, 2, 3, &c. being proposed as *Rationals*; You have heard, I suppose, (though it seemes Mr. *Hobs* have not,) $\sqrt{2}$, $\sqrt{3}$, $\sqrt{4}$, &c. called *Irrationall*. But, this (I said) was but what *Euclide* calls *Incommensurable* (to those exposed *Rationalls*) not *Irrationall*: And that by *Irrationall* he intended only such as were not so much as *potentia*
c. *incommensurabiles*

commensurables; that is, whose *Squares* are not commensurable to the *Squares* of the Exposed Rationalls. Thus 2 being exposed as *Rationall*, $\sqrt{2}$ will be *Incommensurable*, but not (in *Euclides* sense) *Irrationall*, (because 4 the square of 2, and 2 the square of $\sqrt{2}$, be commensurable:) but $1 + \sqrt{2}$, will be *Irrationall*, because its square $3 + 2\sqrt{2}$, is not commensurable with 4 the square of 2. If you never heard or met with the word *Irrationall* used in that former sense; You may think this Intimation, of *Euclides* using it in the latter sense, superfluous: But if You have; You may think Mr. *Hobs* his cavill pag. 83. may very well become him, but not another man.

I have now insisted so long upon the Name of *Ratio*, that You may possibly think 'tis more than it deserves. But I have the rather done it, because, though Mr. *Hobs*'s Objections were not worth half the while; Yet *Ratio*, well understood, being the Life of Mathematicks, (as being of such Univerfall influence into every part of it, upon all occasions,) You will think, though the Objections do not, the Subject may deserve a little time to be spent in the Clearing of it. And I would willingly write something, (since I am a writing) that may be more *Considerable*, than, shewing that what Mr. *Hobs* hath said, is not.

I shall therefore next consider *Euclide's* Definition of *Ratio*. Which hath fared the worse with Mr. *Hobs*, because I have formerly explained it, so as to make it intelligible, and significant at a better rate than as Mr. *Hobs* expounds it (*Less.* p. 8.) *A what-shall-I-call-it As-ness or So-ness of two Magnitudes.* or (as p. 16.) *a Whatshicall habitude of two Quantities*: Reproaching it upon all occasions, (*Less.* p. 7, 8, 16, 20. *Dial.* p. 44, 45, 82, 88, 100,) as, that 'tis *Intolerable, Insignificant, Inept, Ridiculous, As bad as any thing was ever said in Geometry, by Orontius or my self, That Euclide was confounded; did but Tussire;* (as not knowing what to say) *did not well understand the nature of Proportion.* &c. The Definition is (3 def. 5.) $\Delta\beta\omicron\varsigma \ \epsilon\tilde{\iota} \ \delta\delta\omicron \ \mu\epsilon\gamma\alpha\tilde{\iota}\nu \ \delta\iota\omicron\upsilon\lambda\omicron\tilde{\iota}\nu$

ἡ ἀναλογία ἀπὸ ἀλλήλων ποιεῖται ὁμοιομετρία. Which Mr. *Hobs*,
 (*Dial.* p. 44.) renders thus, *Ratio est duarum magnitudi-*
nium ejusdem generis mutua quadam habitudo. So that, ἡ
 ἀναλογία signifies nothing: ποιεῖται, *quodam*: and ὁμοιομετρία, *habitu-*
do. But what *habitudo* means, he cannot understand, p. 82. He
 thinks p. 45. it signifies a kind of *having*, or *being had*: And
 the best he can make of it (p. 45. & *Less.* p. 8.) is but this,
 that it signifies a certain *asness* or *soness*: And blames me
Dial. p. 101. for taking *Habitudo*, to signify *Relatio*. For he
 thinks, p. 100. that *habitudo* (being derived from *habeo*)
 must signify the same with *habitus*, which is *facilitas agendi*
consuetudine acquisita. (And if I should tell him that *Ha-*
bitudo and *Habitus* differ as much as ὁμοιομετρία and ἔξω, I sup-
 pose he would say; That's nothing at all; no more than
 ὁμοιομετρία and ἔξω, the two *Futures* of ἔχω.) And a Phansy he
 hath (which because he thinks it of moment, he gives us
 more than once, *Less.* p. 8. *Dial.* p. 45.) that *Euclide*, in
 the word ὁμοιομετρία, did only respect that *Form* of *Speech* amongst
 the *Greeks*, ὅπως ἔχει (*ita se habet*:) and that, if they had
 expressed *Proportion* by ὅπως ἔστι, *Euclide* would have defined
 it by ποιεῖται ὅμοιομετρία, as now he doth by ποιεῖται ὁμοιομετρία. (But, I perceive,
 Mr *Hobs*, is not very good at *Guessing*: nor doth he take
 his *Aime* right: For *Euclide*'s constant phrase is ὅπως ἔστι,
 not as Mr *Hobs* supposeth ὅπως ἔχει. And yet he doth not
 define *Proportion* by ποιεῖται ὅμοιομετρία, but ποιεῖται ὁμοιομετρία. And
 had Mr *Hobs* consulted *Euclide*'s *Greek*, he would have
 found no footing for that *Phansie*. But, 'tis like the *Dili-*
gence which he is wont to use in his *Observations*.)

But, (though Mr *Hobs* be of another *Opinion*) with
 You, I suppose, it will not be absurd to say that *Habitudo*
 is a *Relation* (not a *Habit*) and that ὅπως ἔχει ἀπὸ τοῦ, (*ita*
se habet ad,) if it had been *Euclides* phrase, might well
 enough referre to what *Aristotle* calls τὸ ἀπὸ τοῦ τι *Re-*
lation.

And that ποιεῖται, may be somewhat more than *nis quadam*,
 I believe you may be apt to grant also: and, that it may
 imply

imply τὸ ποῖον, *Quality*. For though Mr *Hobs* p. 45, 82. &c. may despise *Aristotles Prædicaments*, (because he thinks his own *Prædicaments* better,) Yet that *Aristotles Prædicaments*, may give light as to the use of Words in *Euclide* (and somewhat more than those of Mr *Hobs*) You will think it more than possible. For they did not live either so long, or so far, asunder; but that they might well enough conform one to the others language; or both to the common language of that Time and Place. And therefore that ποῖα ἔσσις, may be a *Qualitative Relation*, or such a Relation as may appertain to Quality. And, ἡ καὶ πλεονέχεια ποῖα ἔσσις, such a Relation as appertains to the *Quality*, but ariseth from the Respective *Quantity* of those Magnitudes.

For though to Mr *Hobs*, p. 101, it seems very strange, that *Figures should be otherwise compared in Geometry than as to their Quantity*, (How Great :) Yet to You it will not be strange at all, That, beside the *Area* of a Figure, *Quanta sit*; a Geometer may consider also the *Species* of it, *Qualis sit*. (What kind of Figure, or of What Fashion; as well as How Great.) And that a Figure may be *Specie data*, when it is not *Magnitudine data*. To say, It is *Talis*, Such a Figure, and, *Tanta*, So Big; are two things. To say that such a Field contains an *Acre*, determines the *Quantity*; but to say, 'Tis *Round*, *Square*, *Triangular*, *Aquilater*, *Equicrural*, &c. determines, *Qualis*, What kind of Figure 'tis: and is thought by *Aristotle* to belong not to his τὸ ποῖον, the *Prædicament* of *Quantity*; but to his τὸ ποῖον, the *Prædicament* of *Quality*. And though *Superficies* be a *Species* of *Quantity*; yet *Figura* (as *Triangulum*, *Quadratum*, *Circulus*, &c.) is with *Aristotle* (though perhaps not with Mr *Hobs*) the fourth *Species* of *Quality*. (Which is indeed a *Modus* of *Quantity*, but a *Species* of *Quality*.) And I believe that *Euclide* (in using the Word ποῖα) did rather respect that which *Aristotle*, than that which Mr *Hobs*, calls ποσόν.

Now I need not tell you, that determining the *Species* or *kind* of *Figures* depends upon the *Proportion*, and the *Position*, of its *Parts*, or *Bounds*, each to other. And according as both those, in two *Figures*, be or be not the same; those *Figures* are called *Like* or *Unlike*. Which Words, I said, are used to denote an agreement or disagreement in *Quality*; like as, *Equal* and *Unequal*, in *Quantity*. And if Mr *Hobs*, p. 45, 82. take it to be a *κατὰ ποιότητα* thus to argue; *Proclus*, it seems, was *κατὰ ποιότητα* as well as I. For he tells us (upon that of *Euclide*, *All Right Angles are equal*.) Οἱ μὲν τὸ Ποσὸν ὁρῶντες ἢ ᾗωνόν, ἢ ὁρθὸν ἴσιν ἢ ὁρθῇ λέγουσιν οἱ δὲ τὸ Ποσὸν, Ὀμοίως, (lege Ὀμοίαν.) Ὅσῳ γὰρ ἴσιν ἐν Ποσοῖς, ἢ ἴσους. οὕτω ἐν ποῖς Ποσοῖς, ἢ Ὀμοιότητις. *Right Angles, as to the Quantity, are said to be Equal; but, as to their (Fashion, or) Qualitie, Like. Equality, in Quantities, being the same that Likeness is in Qualities.*

And both of those *Respects* (that of *Proportion*, and that of *Position*) are *ποταὶ χέσεις*, *Qualitative Respects*, (as determining the *Figure*, a *Species* of *Quality*;) but this of *Position*, κατὰ τὴν κείμεναι, as to the *Situation* of the *Parts*; that of *Proportion*, κατὰ τὴν πλῆκότητα, as to their *Respective Greatness*. In *Numbers*, (which have nothing of *Local Position*;) that of *Proportion* hath only place; and doth therefore (without that other) determine *Similitude*. As two *Numbers* (suppose $6 = 2 \times 3$, and $24 = 4 \times 6$;) are said to be *plani Similes*, if their *Factores* be proportional. As on the other hand, in *Angles*, where the *Length* or *Proportion* of the *Crura* is not at all considered, there *Position* alone determines their *Likeness* or *Unlikeness*, (as well as *Equality* or *Inequality*) as you heard but now out of *Proclus*. But in *Figures*, we consider both.

I have insisted the more on this, because I find that others, as well as Mr *Hobs*, are apt, through inadvertency, (and because we are not now wont, in ordinary Speech, to call *Figure* a *Quality*;) not to consider, that *Proportion* is

one of those two things which do determine ποῖος ὅμοιος, and is therefore ποῖος ὁμοιος. (Nor are we to consider what it is now a daies called in ordinary speech by Us, or how it now stands in Mr *Hobs's* Prædicaments; but how the *Greeks* did Then call it, and how it stood in Their Prædicaments; if we would know what ποῖος signifies in *Euclide*.) And this Inadvertency, may be the reason, why most Interpreters, neglecting the Emphasis of ποῖος have rendred it by *quodam habitudine*, as if it were in Greek ὁμοιος τῷ, not ποῖος ὁμοιος.

And therefore I should chuse, as heretofore (notwithstanding Mr *Hobs's* cavill, that *qualitativa* is not Latine,) to render it thus, *Ratio est duarum Magnitudinum homogenearum, qua secundum quantitatem est, ad invicem habitudine qualitativa*. (Where *qualitativa* distinguisheth *Ration*, from that Relation which concerns the *Difference* or *Excesse*, Or, as the Scholiast calls it, that ἄλλο ὁμοιος, which is καὶ τὸ ὑπερχειν καὶ ἐνείπαι, which is *Quantitative*; And, *secundum quantitatem*, distinguisheth it from that other Qualitative Relation which concerns the *Position*; as that wherein a *Rhombus* differs from a *Square*.)

And this I take to be the true Emphasis of *Euclide's* Definition: Save that I am to adde further, as to that καὶ πλειόνητα, (what I know Mr *Hobs* will not allow me) that the πλειόνητα or *Quantity* which here is meant, is that which we call *Quotient*, (in the largest sense;) which is the Result of Division, (whether a true Number, as in some cases, or Homogeneous to it, as in all cases.) I know that Mr *Hobs* would with great disdain resent this Assertion: As having, p. 86. already declared his sense to the contrary. For though, as to the Antiquity of the *Chaldean* Astrology, when *Hobs* thought I could not, *Thomas* was of opinion, 'twas possible I might have seen some Author of my judgment: Yet here they both agree, that I did but play the Mountebanck, in saying *Some*, when I did not know *Any* of that opinion; For so 'tis concluded, pag. 86.

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He doth not believe that I ever saw any Author who did interpret the *Quantitie* of Proportion in this manner. For either he was himself, or did think me, so ignorant, as not to be able to assigne any. But of this (because you see there is no dealing with Mr Hobs, but *signatis tabulis*;) I shall give you an account by and by, (that by *παικότης* he means what we call the *Quotient*.) At present I shall only tell you, out of the Scholiast, why he doth use the word *παικότης* the *Quantity*; rather than *ποσότης*, the *Quotity*. And 'tis the same with that for which I say *Quantuplum*, rather than *Quotuplum*; because, of a more large extent. For so his Scholiast tells us, *ἐπὶ μὲν τῶν ἀειμῶν πᾶς λόγος ῥητὴν ἔχει ποσότητα ἐπὶ δὲ τῶν μεγάλων οὐκ ἔστι πᾶς λόγος, ὅς ἐστι δύναται ῥηθῆναι ἀειμῶν. — καὶ διὰ τῆς περιόδου ἐν τῷ ἀειμῶν τῷ λόγῳ τῶν μεγάλων, τὸ καὶ παικότητα. Ὁ μὲν γὰρ ῥητὸς, καὶ καὶ παικότητα καὶ καὶ ποσότητα ἐστὶν ἐπὶ πάντως καὶ καὶ παικότητα, καὶ ῥητὸς.* He tells us that, *In Numbers, every Ratio hath an Effable Quotity or Quotuplicity*, (a Quotient explicable in numbers, which determines *Quotuplum*;) but in *Magnitudes*, there may be *Ratio*, which cannot be explicable by Number. And that for this cause Euclide in his definition of the *Ratio* of *Magnitudes*, saies (καὶ παικότητα) as to the *Quantity*, or *Quantuplicity*, (which determines the *Quantuplū*; not the *Quotity* which saies *Quotuplum*;) For though the *Effable*, have not onely a *Quantuplicity*, but also a *Quotuplicity*; yet there is not alwaies an *Effable Quotuplicity*, where there is a *Quantuplicity*. Where though he do extend the *Quotuplum* (larger than perhaps Mr Hobs would allow) to all proportions explicable in true numbers; yet his *Quantuplum* he extends further.

And I hope, by this time, *Euclide's* Definition, is *Intelligible*, and *Significant*. By *ῥέσις*, *habitude*, is meant what we call *Relation* or *Respect*; and by *ποιὰ ῥέσις*, a *Qualitative Respect*, or *Respective Quality*; and by *Quantitie* (not the τὸ ποσόν, but the *παικότης*) the *Quotient*, or *Quantitie*, from whence the *Quantuplum* is denominated. And so the whole

whole definition amounts to this, that *Ration* or *Proportion*, is the *Respective Qualitie*, of two *Homogeneous Quantities*, or *Magnitudes*, as to the *Quotient*. Which I take to be somewhat more significant, than Mr *Hob's* *Assesse*, or *Somme*.

We shall next consider what is meant by *Rationis Compositio*. And I have said formerly, that there is a *Twofold Composition* of *Proportion*. The one by *Multiplication* of the *Exponents*; the other by the *Addition* of them (as when we say, the *Double* of the *Treble* is equal to the *Sextuple*; but the *Double* and the *Treble* is equal to the *Quintuple*.) And both these are (not only in the *Hodiern* *Mathematicks*) but in *Euclid's* *Elements*, called *Composition*. The former in the last definition of the sixth Book; and the latter, in the fourth definition of the fifth book. (And this Mr *Hob*, when he pleaseth, can acknowledge, as *Less.* p. 8. where he tells us, that the *Compositio Rationis*, which *Euclid* defines in 14 def. 5. is not the same which he defineth before the sixth Element.)

That last Definition of his sixth book is this, λόγων συγκεῖσθαι λέγεται, όταν, αἱ τῶν λόγων πλειόνητες ἐφ' ἑαυτὰς πολλαπλασιασθεῖσαι, ποιῶσι τινά. (For though some Copies have πινὰς, yet I take τινὰ, to be the better reading; and Mr *Hob*s allows it: only whereas Mr *Hob*s thinks it to be thus supplied, τινὰ λόγον, I think that *Euclid* doth rather mean τινὰ πλειόνητα, notwithstanding the authority of Mr *Hob*s's Anonymous Book of an hundred years old, which, citing the Proposition, saith τινὰ λόγον.) As of 2 to 3, and 4 to 5, the *Compound Proportion* is that of 8 to 15.

What is meant by πλειόνητες, (which is the only thing in question in this definition) I said, Interpreters do not all agree. Some take πλειόνητες λόγων, the *Quantities* of the *Proportions*, here meant, (and Mr *Hob*s with them) to be the *Antecedent* and *Consequent* of each *Proportion*. And then their meaning is, that the *Antecedent* of the first, multiplied

multiplied into the Antecedent of the second, produceth the Antecedent of the third, (as $2 \times 4 = 8$.) And the Consequent of the first, into the Consequent of the second, produceth a third Consequent, (as $3 \times 5 = 15$.) And there is no great inconvenience if the words be so taken; the sense, even thus, being sound. (But then we must read it *τινάς*, not *τινά*, for if *πληκόμεναι* be the *Terms* of the Proportion, then is the new Antecedent one *πληκόμεναι*, and the new Consequent another. But Mr Hobs, though he embrace that Notion, will not allow that reading. And if he think to salve it with his *τινά λόγον*; as if the two new Terms, did *ποιεῖν* *τινά λόγον*; he must consider that *ποιεῖν* is here a Technical word, and that which *πληκόμεναι* *πολλασθεῖσαι* *ποιεῖ*, is the *Factum*, or *Product* of a Multiplication; and he must not allow that the *Term* of the Proportions, that is, the *Absolute-Quantities*, do by Multiplication Produce a *Ration*, which, he saith, is not an *Absolute* but *Relative* quantity.)

Others (though Mr Hobs cannot believe it) do by *πληκόμεναι* understand the *Quotient*, (or the *Exponent* of the Proportion:) And so (in the case proposed) $\frac{2}{3}$ and $\frac{4}{5}$ (the Exponents of the two *Component* Proportions, 2 to 3, and 4 to 5) do by multiplication produce ($\frac{8}{15} = \frac{2}{3} \times \frac{4}{5}$) the new *Exponent* of the Compound Proportion. (And then we must read it *τινά*, as some Copies, and most Expositors do agree: for the new Exponent is but one, though the Terms of that new Proportion be two. Yet not *τινά λόγον*, but *τινά πληκόμεναι λόγον* (and so Theon supplies it; as Meibomius acknowledges *Dial. Prop. p. 25, 79. And pag. 96.* himself so supplies it as to this opinion.) For the two *Exponents*, by Multiplication, produce, not a Proportion, but an *Exponent* of a new Proportion.)

Now though I said that, either way, the Result of the Definition amounts to the same issue (whether we say

$\frac{2 \times 4 = 8}{3 \times 5 = 15}$ or $\frac{2}{3} \times \frac{4}{5} = \frac{8}{15}$) Yet (to justify my assertion) for

Mr Hobbs doth not believe, that ever any but my self did take *πληκόντες* to be meant in the latter sense) I shall out of *Ευδοκίμης*, (in his Comment on the fourth prop. of the second book of Archimedes, *de Sphæra & Cylindro*; and cited by *Meibomius*. p. 15.) tell you what in his daies, and those before him, was thought to be meant by it, (for should I produce any *Modern Interpreters*, they might be condemned for *Hodiern* as well as I:) who, in order to prove, that, *If between two Numbers, or Magnitudes, we interpose a Middle term; the Proportion of the first to the third, is compounded of the Proportion of the first to the Middle, and of the Middle to the third*; He thus proceeds. Ὑπομνησέον δὴ ὑπερβαρὺν, πῶς ἐλέγχο λόγῳ ἐκ λόγων συγκεῖσθαι. ὥς γὰρ ἐν τῇ στοιχειώσει, ὅταν αἱ τῶν λόγων πληκόντες, ἐφ' ἑαυτὰς πολλαπλασιασθῇσαι, ποιῶσι πρῶτον. πληκόντι δὲ δηλονότι λεγόμενης τῆ ἀειθυμῆς, ἣ παρωθυμῶς ἐστὶν ὁ διδόμενός λόγος. ὡς φασιν ἄλλοι τε, καὶ Νικμάχος ἐν τῷ πρώτῳ περὶ Μουσικῆς, καὶ Ἡρώνας ἐν τῷ ὑπομνήματι πρὸς εἰς ἀειθυμικὴν εἰσαγωγὴν. ταυτὸν δ' εἰπὼν, καὶ τῆ ἀειθυμῆς τῶ πολλαπλασιαζομένῳ ὅπῃ δ' ἐπόμενον ὅσον τῆ λόγου καὶ ποιῶντι δ' ἡγούμενον, &c. We are first (saith he) to consider how, of Proportions, a Proportion is said to be Compounded. That is, (as in the Elements) when the Quantities (*πληκόντες*) of the Proportions, multiplied into each other, do produce a new one. Where, by the Quantitie (*πληκόντες*) is meant, that Number from which the Proportion takes its Denomination. (And so say, as others, so particularly Nicomachus in his first book of *Musick*; and Heronius in his *Commentarie on the Arithmetical Introduction*.) that is to say, that Number, which, multiplied into the Consequent Term of the Proportion, produceth the Antecedent. And this Quantitie (saith he) is most properly assigned in Multiple proportions. But in the Superparticular and Superpartient, it is not to be assigned without dividing an Unite. So that in these an Unite is to be divided, which is not properly Arithmetical, but Logistical; and it is to be divided according to such part or parts, as the proportion

proportion is denominated by. So that (to speak yet more plainly,) the Quantity of the Sesquialter proportion, is one Unite and an half, $1\frac{1}{2}$. That of the Sesquitercian, one Unite and a third part, $1\frac{1}{3}$. So that (as was said before) the Quantity of the Proportion, multiplied into the Consequent term, produceth the Antecedent. For of 9 to 6, which is Sesquialter, the Quantity $1\frac{1}{2}$ multiplied into 6, produceth 9. And in like manner, in other proportions. And these things thus premised; Let the two numbers given be A B, and a third taken at pleasure C. We are to shew, that the Proportion of A to B is compounded of that of A to C, and of C to B. Let the Quantitie of the Proportion of A to C, be D; and of C to B, E. And let E into D, make F. I say that F is the Quantity of the proportion of A to B: that is, if F multiply B, it will make A. For, let B multiplied by F, make G. Forasmuch then as B into F, makes G; and B into E, makes C: therefore as F to E, so is G to C. Again, forasmuch as D into E, makes F; and D into C makes A: therefore, as E to C, so is F to A. And (alternately) as E to F, so C to A: And (inversely) as F to E, so A to C. But we have shewed, that as F to E, so is G to C. Therefore, as G to C, so is A to C. And therefore A is equal to G. But B into F makes G, therefore B into F makes A. F therefore is the quantitie (πληρότης) of the Proportion of A to B. But F is the product of D multiplied into E; that is, of the Quantitie of the Proportion of A to C, into the Quantitie of the Proportion of C to E. The proportion therefore of A to B, is compounded of that of A to C, and of C to B. Which was to be demonstrated.

A
 C
 B
 D
 E
 F
 G

But to the end that, by an Example, I may farther make clear what hath been said. Let, between the numbers 12 and 2, a middle number be 4. I say, that the proportion of 12 to 2, that is, the sextuple, (λόγος ἑξαπλαστικός,) is compounded of the triple, (τὸ triπλαστικόν,) 12 to 4, and of the double (τὸ διπλαστικόν)

$\pi\lambda\alpha\sigma\iota\upsilon$) 4 to 2. For if the Quantities of these Proportions be multiplied one into the other, that is 3 into 2, it makes 6, which is the Quantitie of the Proportion of 12 to 2, (which is sextuple;) as was proposed to be shewed.

But in case that middle term interposed, happen not to be lesse than the greater, and greater than the lesser (of the two given terms,) but contrariwise, greater than either, or lesser than either; yet even thus the foresaid composition will follow. Between 9 and 6, let a middle term interposed, greater than either, be 12. I say, that, Of the subsupertertian ($\tau\acute{\epsilon}\varsigma\ \sigma\upsilon\mu\pi\epsilon\tau\epsilon\tau\epsilon\tau\iota\alpha$) that of 9 to 12, and of the duple, that of 12 to 6, is composed the sesquialter, that of 9 to 6. For the Quantitie of the Proportion of 9 to 12, is $\frac{3}{4}$, that is, $\frac{1}{2}$ and $\frac{1}{4}$; and the Quantity of that of 12 to 6, is 2. If therefore we multiply 2 into $\frac{1}{2}$ and $\frac{1}{4}$, the product is $1\frac{1}{2}$, which is the Quantitie of the Sesquialter Proportion, which 9 bears to 6.

In like manner, if between 9 and 6, the middle term interposed be 4; Of the proportions of 9 to 4, which is duple-sesquiquartan; and of 4 to 6, which is subsesquialter, is compounded the Sesquialter proportion. For if again we multiply the Quantitie of the Duple-sesquiquartan, which is $2\frac{1}{4}$; into the Quantity of the subsesquialter proportion that is $\frac{2}{3}$; we shall have $1\frac{1}{2}$ the Quantity of the sesquialter proportion, as was said before. And in like manner 'twill hold in all cases what ever.

From what is said, 'tis also manifest, that if between two Numbers, or two Magnitudes given, there be interposed, not one but more intermediate terms; the proportion of the Extreams is compounded of all the proportions which each term hath with his immediate subsequent, beginning at the first, and ending at the last, according as they follow in order. For

between two terms A, B, let more than one be interposed, C, D. I say that the proportion of A to B, is compounded of that of A to C, and of C to D, and of D to B. For seeing that of A to B is compounded

A
 C
 D
 B

E 2

of that of *A* to *D*, and of *D* to *B*, as was said above; and that of *A* to *D*, compounded of that of *A* to *C*, and of *C* to *D*: Therefore that of *A* to *B* is compounded of that of *A* to *C*, and of *C* to *D*, and of *D* to *B*. And the same will in like manner be shewed in all other cases. Thus far *Eutocius*.

I forbear, as needlesse, to cite *Theon* and others to the same purpose. (This alone, is enough to make *Credible*, what Mr *Hobs*, could not believe, That some other beside my self did understand *πληρότης*, the *Quantities* here spoken of, in this sense.) But this out of *Eutocius* I have the rather produced at large, as well because of that clear account he gives us of *Compounded Proportion*, and of *Euclide's Definition* thereof, as himself and the Antients did understand it; As also because I find that Mr *Hobs* is not the onely person, who, looking no further than the *Latine Translations*, is apt to understand *Quantitas*, as if here used in such a sense, as when we call a *Quantitie* that which Mr *Hobs* would have us call a *Quant*; and so to take the *πληρότης λόγων* for the *Terms of the Proportion*, (the *Antecedent* and *Consequent*,) or the *Quantities Compared*; which *Euclide* useth to call *μεγέθη*, the *Magnitudes*; not *πληρότης*; (Which mistake is the more advanced, because *Euclide* speaking here of more Proportions than one, saith *πληρότης λόγων*, whereas had he spoken but of one, and said in the singular *πληρότης λόγου*, the mistake had not been so easie :) Not attending that *Euclide* (who doth not take a pride in needlesse varying Words and Phrases, but is rather rigidly tenacious of his forms of Speech) doth by *πληρότης Quantitie* (which is in such manner different from *ποσότης Quotitie*, or *Quotient* strictly so called, though Homogeneous to it, as *Quantuplum* from *Quotuplum*), mean that *Quantitie* (rather than *Quotitie*) effable or uneffable, which denominates the *Quantuplum*, or which multiplying the Divisor doth produce the Dividend, or multiplying the Consequent doth produce the Antecedent Term of the Proportion. (Which rightly understood, addet

addeth a great light to those two Definitions of *Euclide* where that Word is used; that of *Ration* or *Proportion*, 3 d 5. and that of *Compounded Proportion*, 5 d 6.)

Thus if $\frac{A}{B}$ and $\frac{C}{D}$ (the *Quantities* or *Exponents* of the two Proportions, that of A to B, and of C to D,) be multiplied the one into the other; the product $\frac{AC}{BD} = \frac{A \times C}{B \times D}$

is the Exponent of a *Ration*, which by this Definition is to be called, the *Compound* of those two. And what *Euclides* doth demonstrate; That of any three Magnitudes A, B, C; the Proportion of the first to the third, is compounded of that of the first to the second, and that of the second to the third:

is evident; because $\frac{A}{B} \times \frac{B}{C} = \frac{AB}{BC} = \frac{A}{C}$. And, were there

never so many, yet still $\frac{A}{B} \times \frac{B}{C} \times \frac{C}{D} \times \frac{D}{E} = \frac{A}{E}$. For the intermediate terms, being first Denominators, and then Numerators, of the Exponent Fractions, do still destroy themselves, how many soever they be.

And when *Euclide* defines, 7 to d 5, If A, B, C, D, &c. be in continual Proportion, (that is, if that of A to B, be the same with that of B to C, and of C to D, &c.) the Proportion of A to C is Duplicate, and that of A to D Triplicate, &c. of that of A to B. 'Tis as much as to say that a Proportion thus compounded of Equal Proportions, two, three, or more; is said to be Duplicate, Triplicate, &c. of each of them ($\delta\iota\pi\lambda\alpha\sigma\iota\alpha\varsigma$, $\tau\epsilon\tau\pi\lambda\alpha\sigma\iota\omega\varsigma$, &c. not $\delta\iota\pi\lambda\alpha\delta\iota\sigma\iota\theta$, $\tau\epsilon\tau\pi\lambda\alpha\delta\iota\sigma\iota\theta$, &c. For that $\lambda\omicron\gamma\theta$ $\delta\iota\pi\lambda\alpha\delta\iota\sigma\iota\theta$, &c. signifies another thing

we heard but now:) For then $\frac{A}{C}$, that is, $\frac{A}{B} \times \frac{B}{C}$, that is,

$\frac{A}{B} \times \frac{A}{B}$, or $\frac{AA}{BB}$, is the Exponent of the Duplicate, and $\frac{A}{D}$,

that is, $\frac{A}{B} \times \frac{B}{C} \times \frac{C}{D}$, that is, $\frac{A}{B} \times \frac{A}{B} \times \frac{A}{B}$, or $\frac{AAA}{BBB}$, of the Tripli-

cate, of $\frac{A}{B}$ or that of A to B. Thus the Double of the Double, the Treble of the Treble, the Quadruple of the Quadruple, &c. and the Half of the Half, the Quarter of the Quarter, &c. are in Duplicate proportion, to the Double, Treble, Quadruple, &c. the Half, the Quarter, &c. And the Double of the Double of the Double, is Triplicate of the Double. And so of the rest.

But here Mr *Hobs* can neither agree with *Me*, with *Euclide*, nor with *himself*. He had told us, in his *Latine* Edition (*Corp. cap. 13. § 16.*) that (of quantities in continual proportion) *If the Proportion be of the Greater to the Lesse, the proportion of the First to the Third is Double of that of the First to the Second; and that of the First to the Fourth, Treble; meaning (as he tells us) by Double and Treble, that which is commonly called Duplicate and Triplicate. But if the proportion be of the Lesse to the Greater; the proportion is not properly said to be Multiplied, but Submultiplied; (for Submultiplicari was not then a Barbarous word; though now Dial. p. 50, 51. Supduplum be) and that of the First to the Third is the Half; and that of the First to the Fourth is the Third part, of that of the First to the Second; meaning by the Half, the Third part, &c. that which is commonly called the Subduplicate, Subtriplicate, &c. (And yet he there presently addeth; that a Proportion is Divided, by interposing Mean-proportionals between the Quantities compared: As if it were one thing to Submultiply by 2, another thing to Divide by 2: And, of the proportion of 1 to 9, the Half (by Submultiplication) were that of 1 to 81; and yet the Half (by Division) were that of 1 to 3: And Euclide mistaken when he tells us that ejusdem dimidia sunt inter se aequalia.)*

But when I had told him in my *Elenchus*. That to Submultiply was all one as to Divide; And, that whether the

the continued Proportion were of the Greater to the Less, or of the Lesse to the Greater, yet still that of the First to the Third was Duplicate (not Subduplicate) of that of the First to the Second. He mends it, in the English, thus. *If the Proportion be of the Greater to the Lesser, as 4, 2, 1; That of 4 to 1 is not onely the Duplicate, but also twice as Great, as that of 4 to 2.* (Which yet doth not alwaies hold: For that of $\frac{2}{3}$ to 1 is duplicate, but not twice as great, as that of $\frac{2}{3}$ to $\frac{1}{3}$; though $\frac{2}{3}$, $\frac{1}{3}$, 1, are in continual Proportion of the greater to the lesse: and that of 9 to 1, is not onely duplicate, and at least twice as great, but thrice as great, as that of 9 to 3.) *But when the Proportion is of the Lesse to the Greater, as 1, 2, 4. that of 1, to 4. (he sayes) is duplicate, yet not Twice as Great; but contrarily the Half, of that of 1 to 2.* (For, Now, Duplicate is not the same with Double, or twice as great; Yet is to be, again, by and by. For he tells us, Dial. p. 88. *Quicquid duplicatur, fit non minus Duplum quam Duplicatum, & ut ratio 1 ad 4 est Duplicata rationis 1 ad 2, ita etiam Dupla est.* And yet again p. 178. *Rationem 1 ad 4 Duplicatam esse rationis 1 ad 2; rationem tamen 1 ad 2 majorem esse quam Ratio 1 ad 4; Paradoxa non sunt, Absurda sunt.*)

When he had thus, in his English Edition, mended that of the Latine: He doth yet in his *Lessons* (published at the same time with the English) p. 23. resume what he had laid aside, (that 1 to 4 is not Duplicate but Subduplicate of 1 to 2;) *Because 1 to 4 is Lesse than 1 to 2; and it is Absurd to say, that the taking the same Quantities Twice, should make it Lesse.* (And yet affirms, Dial. p. 51. *Ex duplicatione aliquid fieri posse aliquando minus.*)

So that the proportion of 1 to 4, to that of 1 to 2, he tells us sometimes, is not Duplicate but Subduplicate; Sometimes, 'tis Duplicate, but not Double; Sometimes, is both Duplicate, and Double; Sometimes 'tis neither Duplicate, nor Double: That, to say, it's Duplicate, and yet Lesse, is sometimes Absurd; sometimes, 'tis very True.

Which minds me of a late Treatise of Yours, that You were pleased to favour the World withal, concerning *Fluiditie* and *Consistence*: For if, by *Fluent*, You mean that which is opposite to *Consistent*; You must needs acknowledge Mr *Hobs* to be one of the most *Fluent* Writers You have yet met with.

But, what ever become of the Proportion of 1 to 4, in reference to that of 1 to 2; whether it be *Double*, or *Duplicate*, or *both*, or *neither*; Yet, that *Double* and *Duplicate* are every where the same, he doth oft tell us: That *Euclide* never useth but one word διπλασιον for both, (for τὸ διπλασιον is the Neuter both to ὁ διπλασιος and ὁ διπλασιων:) That they differ, in what subject so ever, he never yet heard: That inter διπλασιον & διπλασιονα differentiam nullam observant, neq; Grammatici neq; Mathematici Græci: nor the Latines, between Duplum and Duplicatum: That *Euclide* doth use διπλασιος and διπλασιων (though he never use but one word) promiscuously for the same thing: That by λογος διπλασιων (10. def. 5.) *Euclide* meant nothing else but λογος διπλασιος, &c. Leff. p. 21, 22, 42, Dial. p. 50, 51, 88. & alibi.

And yet, after all this confidence, he doth allow Dial. p. 101, That I have deservedly reprehended *Meibomius* for emending some places of the *Antients* by διπλασιος which should have been emended by διπλασιων. And, upon conference, pag. 101. *Thomas* and *Hobs* do both believe, harum vocum alium sensum esse apud Mathematicos, etsi non semper, sepissime tamen. And, as we have heard before, he can sometimes tell us of things not onely *Duplicate*, but also *Double*; others *Duplicate*, yet but the *Half*, not the *Double*, or twice as great.

For his contrary opinion; he allegeth two things: First, their *Etymology* (an Argument on which he doth oft enlay great streffe in *Mathematicks*;) διπλασιος and διπλασιων, (as also *dupla* and *duplicata*) being of a like original must needs signifie the same thing every where (It seems he doth

doth not think that a word of an Ambiguous or Lax signification as to Grammar, may, by a Definition, be restrained in Mathematicks to a Particular Determinate sense: or, that $\pi\epsilon\acute{\rho}\alpha\gamma\omega\gamma\omicron\nu$ in *Euclide*, however he please to define it, is to be taken for a *Square*, rather than a *Rhombe* or *Rhomboide*; for these have four corners as much as that: And in like manner, To *Induct*, and *Induce*; *Conduct*, and *Conduce*; *Refund*, and *Refuse*; *Confounded*, and *Confused*; to *Compound*, and *Compose*, &c. because they are of like Originals, and may in some cases be promiscuously used, may therefore be so used every where, and *do every where signify one and the same thing without any ambiguity.* And it doth not beseem a Geometer, (he tells us) *Theorematum veritatem ex Usu Verborum, aestimare*; but *ex rebus ipsis recte conceptis.* Dial. p. 178. (For he hath now forgotten, that there is no Truth, but the truth of Words.) But till I shall find others *Inducted* or *Induced* to believe, that 'tis as well said, to *Compound* as to *Compose*, a Verse, &c. I must *Refund* or *Refuse* to be of his opinion; and shall think it *Conducting* or *Conducing* to right speaking and understanding, to observe the *Use* of Words as well as their *Originals*.

The other is, that in one place of *Euclide*, $\delta\iota\pi\lambda\alpha\sigma\iota\omicron\nu$ is used for $\delta\iota\pi\lambda\alpha\sigma\iota\alpha$: And because he thinks it of very great moment, we are told it, at least, four times over, (perhaps oftener) *Less. p. 21. & 42. Dial. p. 50, & 88.* 'Tis *pro- ult. 9. Euclidis*; $\text{Ἐάν τις μονάδος ὁποσίων ἀριθμοὶ ἐξῆς ἐκτεθῶσιν ἐν τῇ διπλασίονι ἀναλογία (1, 2, 4, 8, 16, &c.) ὥς ὃ ὁ σύμπτει πρῶτον χρησάμενος, καὶ ὁ σύμπτει ὅταν ἔχῃ πολλὰ πλάσια αὐτῆς ποιῇ πρῶτον, ὁ μὲν οὖν πρῶτον πλάσιον ἔσται}$; which doth prove (and 'tis one of the most considerable Observations, if his own, that Mr *Hobs* hath made) that *Euclide* (according to our present printed Copies) doth, in one place, in the ninth book, mention $\alpha\gamma\alpha\lambda\omicron\gamma\iota\alpha\varsigma \delta\iota\pi\lambda\alpha\sigma\iota\omicron\nu\alpha$, in a different sense from what he had, in the fifth book, defined $\lambda\omicron\gamma\omicron\nu \delta\iota\pi\lambda\alpha\sigma\iota\omicron\nu\alpha$. But it doth not prove (what he would have

have it) that λόγος διπλασίον as it is defined in the fifth book, is the same thing with what is called λόγος διπλάσιος, (which what it is, you heard but now out of *Euclides*, and may, when you please, see the like in *Theon*, *Ptolemy*, and others of the Ancients;) Nor can Mr *Hobs* be so ignorant, as to think, that ἀναλογία διπλασίον in the latter place; is the same with λόγος διπλασίον in the former. (And, left of all will it prove what Mr *Hobs* infers p. 50. that *nulla potest esse ambiguitas in vocibus διπλασιον & διπλασιον, quæ idem significant ubique.*)

But the truth is; though, I do not deny but that *Euclide* himself may possibly, some one time, in the use of a Word, Vary from his own definition; yet 'tis so very rare for him so to do, that I do rather believe, that *Euclide* wrote, neither διπλασιονι, as we now read it, nor διπλασιον, but rather διπλασιον: and that διπλασιονι crept in either by the *Negligence*, or the *Over-diligence*, of some transcribers; I mean, that 'twas either unawares mis-written (and such faults in manuscripts, are but too frequent, especially when the transcribers understand little of what they write;) or, which is the more likely, that some person, who knew no more of the difference between ὁ διπλάσιος & ὁ διπλασίον than Mr. *Hobs*, mistaking διπλασιον, which was there the Genitive Plurall of διπλάσιος, for διπλασιον the Nominative Singular of διπλασιονι, did instead of ἐν τῇ διπλασίον ἀναλογία write ἐν τῇ διπλασιονι ἀναλογία, to mend the Syntax, as he thought, when he did indeed marre the sense.

And a like mistake we may very well suppose possible, in *prop. 20. El. 3.* (and some other places which Mr. *Hobs* hath not observed;) where we meet with γωνία διπλασίον, perhaps mis-written for γωνία διπλασία: the rather, because this proposition is antecedent to that definition to *d 5*; and it is not *Euclides* usuall manner first to make use of a Technicall word in a former book, and then to define it two books after.

'Tis true, that *Euclide* sometimes doth first make use of a word in a vulgar acceptation, which when he comes afterwards to use in a peculiar determinate sense he doth then define. As, having used $\mu\acute{\epsilon}\rho\omicron\varsigma$ a part, in the vulgar acceptation, in his ninth Axiome (*The Whole is greater than its Part,*) and afterwards very frequently in the same sense: he doth yet, when he comes to use it for an *Aliquote Part*, give us a Definition to that purpose, *Def. 1. lib. 5.* In like manner, having, in his tenth Axiome, told us, that *Two straight lines* $\epsilon\ \mu\epsilon\acute{\iota}\chi\upsilon\sigma\iota\varsigma$, do not Comprehend a space (taking the word $\mu\epsilon\acute{\iota}\chi\upsilon\sigma\iota\varsigma$ Comprehend, or Encompasse, in such a sense as Mr. *Hobs's* Nurse would have done;) when he was to use the same word in another peculiar sense, he doth *Def. 1. lib. 2,* so define it; *A straight-lined Parallelogram is said to be Comprehended, $\mu\epsilon\acute{\iota}\chi\epsilon\alpha\delta\alpha\iota$, by the two straight lines which comprehend the Angle.* And in his tenth Book, *prop. 22, 40, 77,* being to use the words *Media, Major, Minor*, in a peculiar sense, different from the vulgar acceptation, he doth there Define them; though, in the vulgar acceptation, they had been often made use of before. But in a following Book, to Define a Word, which had, in the same sense, been often used in the books foregoing, is a thing so unusuall with *Euclide*, as that I beleieve Mr. *Hobs* will not be able to produce any one Instance. (For 'tis his constant practise, when ever he takes a word to be of so unknown, or uncertain, a signification, as to need a Definition, he doth never, in that sense, make use of it, till he hath first defined it.) And therefore if he had taken $\delta\iota\mu\epsilon\tau\epsilon\acute{\iota}\sigma\iota\varsigma$ in *Def. 10. lib. 5.* in no other sense, then as he had before used $\delta\iota\mu\epsilon\tau\epsilon\acute{\iota}\sigma\iota\varsigma$ so often, (and $\delta\iota\mu\epsilon\tau\epsilon\acute{\iota}\sigma\iota\varsigma$ at least once, if our present Printed books deceive us not,) he would either not have defined it at all, or not so late.

What ever therefore become of the Word $\delta\iota\mu\epsilon\tau\epsilon\acute{\iota}\sigma\iota\varsigma$; yet the *Notion* intended by it in that Definition of the fifth Book, (though Mr. *Hobs* would have us think otherwise,) is quite another thing from that of $\delta\iota\mu\epsilon\tau\epsilon\acute{\iota}\sigma\iota\varsigma$ in the books fore-

fore-going. And as for the Two Words, though he tell us, p. 50, 51, that *they do every where signify the Same thing*, and that *Mathematicians do Never observe any difference between them*; yet I cannot beleieve him; because he tells us p. 101, that *most times they do*, if not allways, observe a difference.

But we have not yet done with $\lambda\beta\gamma\theta$ & $\delta\pi\mu\lambda\alpha\sigma\iota\theta$, *ratio dupla*. That the proportion of 2 to 1, or 6 to 3, is wont to be so called (as well by *Ancient*, as *Hodiern* Geometers, Greek and Latine,) is so notorious, that no man (who reads Books) can doubt it. (And Mr Hobs, *Corp.* p. 100. says the same, *ratio 2 ad 1 vocatur dupla*; & 3 ad 1, *tripla*.) But (*Less.* p. 21. and *Dial.* p. 50. and elsewhere) he cannot understand, how it can be *ratio dupla*, *double Proportion*. But why not? Because, *Double Proportion* must needs be the *Double of some Proportion*; now, of what is 6 to 3 the *Double*? Is it the *double of a Number*? or, the *double of a Proportion*? 'Tis the *Double of a Proportion*; of that of 3 to 3, or 1 to 1; as this is the *Treble of 1 to 3*. For so *Theon* tells us, $\epsilon\delta\eta\ \tau\epsilon\tau\pi\lambda\alpha\sigma\iota\theta\ \tau\iota\ \nu\omicron\varsigma\ \delta\pi\mu\lambda\alpha\sigma\iota\delta\omega\mu\epsilon\tau\epsilon\iota$, $\gamma\iota\upsilon\tau\alpha\iota\ \alpha\upsilon\tau\eta\ \epsilon\chi\alpha\pi\lambda\alpha\sigma\iota\theta\ \nu$; (at which *Meibomius* is so much offended,) *If we Double the Treble, we have the Sextuple*, (But the *Duplicate* of the *Treble* is the *Noncuple*.) Mr Hobs, it seems, did not understand, that, as in *Numbers*, when we say *Two* (indefinitely) we are by common usage understood to mean *Two Unites*; but, if we mean two of any other Number, we must expresse it, (as *two Fours*, that is 8, &c;) So, in *Proportions*, when we say indefinitely the *Double*, we are understood to mean, the *Double of the Single*; but if we would be understood of the *Double of any other Proportion*, we must expresse it, (as the *Double of the Quadruple*, that is, the *Octuple*, &c.) Would you have thought that so great a Mathematician as Mr Hobs (would be thought to be) should need a Commentary, to understand a thing so plain?

Another thing wherein his understanding is Deficient is, about the Proportion of Equality, or Single Proportion.

Corp.

Corp. p. 89. Less. p. 16, 17, 18, 19, 20. Dial. p. 45, 46, 47, 102, &c. The Proportion of Unequals, he says, is a Quantity; but the Proportion of Equals, is not a Quantity. (Had he sayd the Difference of Equals is not a Quantity I could have beleev'd him; because they Differ not, or, have no Difference: But why not the Proportion of Equals?) Because one Proportion of Equality is not greater than another Proportion of Equality. (True. Nor one Proportion of Duplicity greater then another Proportion of Duplicity.) And 'tis absurd to aske, *Quanta est Equalitas?* (As much as, *quanta est Duplicitas?*) The Proportion of Equality, as of 5 to 5, is Greater, he says, than that of 5 to 6; and lesse than that of 5 to 3; yet, these are Quantities, but that is not. (But why not?) Because (he tells us) *Ratio Defectus est defectus Rationis*. (The Reason of Deficiency, in his Apprehension, is the Defect of Reason) And he beleev'es, that I cannot design the Ration of Equality, by other than 0 a Cipher: (Yes; by 1, an Unite: For as 3 is the Exponent of the Triple proportion; and 2, of the Duple; so is 1, of the Single, which is the proportion of Equals; and $\frac{1}{2}$, of the Subduple, &c: because the Antecedents do accordingly contain their respective Consequents, Thrice, Twice, Once, and *semel*, Half-once, &c.) And, he says, Proportions of the Lesse to the Greater must needs be Negative Quantities, or lesse than nothing, Because of two Proportions, of the Lesser to the Greater, the Proportion Compounded is lesse than either; (Just as when two Fractions, $\frac{1}{2}$ and $\frac{1}{3}$, are multiplied, the Product $\frac{1}{6}$, is lesse than either of them: and yet, both those, and this, are Positive Quantities, not Negatives.)

That which hath confounded him in this whole business, is that Fundamentall mistake, in deriving Proportion from the Difference, and not from the Quotient of the Quantities compared. For, having so done, because, in Equals, the difference is nothing, he concludes the Proportion to be so too; and consequently, comparing that of Equality

Equality to 0, he must needs compare those of Minority, to lesse than nothing. Whereas had he aright apprehended the nature of Proportion, and derived it from the Quotient, not the Remainder; he would have found that though the *difference* of Equals be *Nothing*, because $A - A = 0$; yet their *Proportion* is *Single* (not *Nullecuple*) because $A : A$ (1. And, of the Lesse to the Greater, though the Excesse be Negative or lesse than nothing, because $1 - 2 = -1$; yet the Proportion is Positive, and denominated by a Positive quantity, but lesse then 1; Not, a Negative: Because 2) $1 : \frac{1}{2}$. Which *Mersennus*, and he, not well observing, take the proportion of Equality, for No-quantity; and Minority, for a Negative, or Privative quantity. As if, the *double*, were indeed *something*; but the *Equal*, *Nothing*; and the *Half*, *Lesse than nothing*.

Nor doth it at all help the matter, to tell us, that by *Ration* he doth not mean a *Concrete*, (the Double, the Equall, the Half;) but the *Abstract*, or (as he calls it) the *Act of differing*. For (beside that his words will not bear this Evasion; *Ratio consistit in Differentiâ, hoc est in ea parte majoris quâ minus ab eo superatur*; where *ea pars majoris*, cannot be the *Act of differing*, but the absolute quantity by which they differ;) if this Evasion be allowed him, it amounts to no more but this, That *to be the double*, is something, (a Positive Ratio or Relation :) *to be equall*, is Nothing, (No Relation;) *to be Half*, is so far from being something, that it is not So-much as *Nothing*; Which I am content to admit for *Half* an Answer; and Mr. *Hobs* for *Half* a Geometrician.

Another Scruple I meet with pag. 91. where I am to give a Reason why I do (in Geometrical Progression) make use of the Letter *R*, to design the Exponent of the common Ratio; Which Mr. *Hobs* thinks should rather be designed by *M*, the first Letter of *Multiple*. (A profound Inquiry! Like that of some, Why *Homer* chose to begin his *Iliades* with

with *M*.) I might tell you (were it fit to detain you upon trifles) That (as himself tells us, pag. 90.) this exponent, which he calls *M*, is *Radix* (of which the severall Powers come successively to be considered) and might, upon that account, be fitly designed by *R*, the first letter of *Radix*, as well as by *M*, the first letter of *Multiplier*. Next, that Geometricall Progression, is defined, not by a *Common Multiplier*, but, by a *Continued Ratio*: and therefore *R*, a fitter Letter then *M*, to design the exponent of that *Ration*. That Geometricall Progression may be carried on, according to any *Ration* whatsoever, as well as the *Multiple*: and therefore fitter to be designed by *R*, than *M*; (and it was not fit to seduce my Reader, as he speaks, or, by the letter *M*, to make him think there can be no other Geometricall Progression, but in *Multiple* proportion.) And had I (as he would now have me) designed it by *M*; I should then have been thus taxed on another account; What? Is there no Progression Geometricall, but only in *Multiple* Proportion? Are not 8, 4, 2, 1, and 8, 12, 18, 27, in Geometrical Progression? Yet the Proportion is in that, *Submultiple*; in this, *Sesquialter*; not *Multiple* in either. Next, that this Common Ratio, may as well be continued by Division, as Multiplication; (and 8, 4, 2, 1, as properly said to proceed by a continued Division by 2, as by a continued Multiplication by $\frac{1}{2}$;) and therefore *R* more proper than either *M* or *D*. Next, that I was at the same time to make use of *M*, (upon another account) for a *Middle-proportionall*; and *D*, for Distance; and therefore *R* was more at leisure, to designe the *Exponent*, of the Common *Ration*; (And I chose that rather than *E*, because *E* is made use of for the Common *Excesse*, in Arithmetical Progression, which I was not willing to confound with the Common *Ration*, in Geometricall Progression, though Mr. Hobs think, they both consist in the Difference.) But, (because I doe not think my self obliged to assigne a Reason, why I make use of this or that Symbol, more than

than *Euclide* or Mr. *Hobs*, why this or that Line or Point, in a Scheme, is designed by this or that Letter,) I shall not insist on any of those Reasons. And, that I be not charged with *Double Pleading*, (a fault in Law, though not in Mathematicks,) I shall assigne but this one; That, being at liberty to use what Symbol I pleased, I chose to make use of *R*: And Mr. *Hobs* hath the same liberty to make use of *M*, or *H*, or what he please.

But as I did not assigne a Reason why I made use of *R*, so, neither hath Mr. *Hobs* assigned *All* the Reasons why he might make choise of *M*, to design the Exponent of this Common Ration. For, (besides what he intimates,) there be some other weighty Reasons, why it was fit he should change my *R* into his *M*.

First, because *pag. 90.* we are thus taught to find this *M*: *Divide the Second term by the First, and the Quotient is M*; which therefore he must not call, the Exponent of the Common Ration; (lest it might be thought that Ration depended on the Quotient;) but, the Common Multiplier; which doth a little better disguise the businesse, than if he had designed it by *R*, and told us in expresse words, that the Ration was to be found by Division.

Secondly, because he undertakes (in the same place) to give a *New* way (from what I had given) for finding out any term in the Progression; suppose, the Fifth; which is (he tells us) *MMMM A*: (supposing *A* to be the first term, and *M* the Common Multiplier, or the Exponent of the Common Ration.) Now because I had said it was *AR* that is *ARRRR*; if he should have retained the letter *R*, it might have been thought his Rule was but the same with mine; (for the transposing of *A* to the last place, which I set first, should scarce have made it passe for a new Invention :) But, transposing of *A*, and changing the Symbol *R* into *M*, makes the Invention perfectly New.

Lastly, because he is by and by (*p. 93, 94*) to furnish a discourse of two Pages, between *Thomas* and *Hobs*, about what may

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81 H O B B I O S
 πλάσιος λόγῳ ὁρᾷ ἡμιόλιον. Ἐὰν γὰρ ἐνὸς ἀριθμοῦ ληφθῶσι
 τετραπλάσιός τε καὶ τετραπλάσιος καὶ πάλιν ἡμιόλιός τε καὶ διπλά-
 σιος ἐπίτευτον ποιῆσι λόγον, ὃ πῦ τετραπλάσιος ὁρᾷ τὴν τρι-
 πλάσιον, καὶ ὁ διπλάσιος ὁρᾷ τὴν ἡμιόλιον. Ὡς τε ὁσῶ συμφωνῶντι-
 ριν ὅτι τὸ διὰ πασῶν τῶν διὰ πέντε, τοῦτέστι συμφωνότερον γίνεσθαι
 καὶ τὸ διὰ διὰ πασῶν τῶν διὰ πασῶν καὶ διὰ πέντε. *The Dis-*
diapason (two Eights) is in proportion to the *Diapente* and
Diapason (an Eight and a Fifth) that is, the *Quadruple Pro-*
portion to the *Triple*; as the *Diapason* (an Eight) to the *Di-*
apente (a Fifth:) that is, as the *Double Proportion* to the *Sesqui-*
alter. (For if, of the same Number be taken the *Triple* and
Quadruple; and again, the *Sesquialter* and the *Double*: they
 make the *Sesquitercian Proportion*; as well the *Quadruple* to
 the *Triple*, as the *Double* to the *Sesquialter*.) So that by how
 much the *Diapason* (an Eight) is more Consonant then the
Diapente (a Fifth) by so much is the *Disdiapason* (two Eight's)
 more Consonant than the *Diapason* and *Diapente*, (an Eight
 and a Fifth.) From whence he may understand, That
Ptolomy was so much infected with Hodiern Mathematicks,
 as to call that of 2 to 1, λόγον διπλάσιον, *Double* propor-
 tion; and that of 4 to 1, *Quadruple* proportion: That *Disdia-*
pason, in Musick, is *Quadruple* proportion; *Diapason*,
Double proportion; *Diapente*, *Sesquialter*; and, there-
 fore, *Diateffaron*, *Sesquitercian*: That the *Diapason*, com-
 pounded of the *Diapente* and *Diateffaron*, is the same with
 the *Duple* compounded of the *Sesquialter* and the *Sesquiterci-*
an: That *Ptolomy* (as well as *Clavius* and I, with other
 Hodiern Geometers) did account Proportions to be in the
 same proportion with their Exponents; and, those Propor-
 tions to be proportionall, whose Exponents are proportio-
 nall; (though Mr. *Hobs*, and his friend *Meibomius* will not
 allow it.) Like as but now you heard from Them, that the
Sextuple is Double to the *Triple*; because their Exponents
 6 and 3, are as 2 to 1.

Which brings me to another Objection of Mr *Hobs*. I said
 that

that, besides that *Composition of Proportion* already spoken of, by *Multiplication of the Exponents*, (as when the Compound of 2 to 1, and of 3 to 1, is that of 6 to 1; that is, the *Double of the Treble* is the *Sextuple*;) there is another *Composition*, by *Addition of the Exponents*, (as when we say, the *Double and the Treble* make the *Quintuple*;) Both which *Compositions* are very frequent both in Ancient and Modern Geometers, (though Mr. *Hobs* will not Believe it, and *Meibomius* doe not Like it :) And both, by *Euclide*, are called *Composition*; (That, in *Def. 5. lib. 6.* This, in *14 Def. lib. 5.*) And Mr. *Hobs*, if he had not forgot his Lesson, would have said so too. For he tells us, *Lesson p. 8.* that the *Composition of Proportion* defined in the *14 Definition of the 5th Book*; is not the same *Composition* which he defineth in the last definition of the *Sixth book*. Thus *Euclide*, *Prop. 9. lib. 6.* Because, *One part of a Right Line* is *Double* to the *Other*; Concludes, That the *Whole* is *Treble*. And why so, but because the *Double and the Single*, make the *Treble*? (like as their Exponents $2 + 1 = 3$.) And, *Prop. 1. lib. 13.* having proved the *Gnomon* to be the *Quadruple* of the *Exempt Square*, he concludes the *Whole* to be the *Quintuple* of it. Why; but because the *Quadruple and the Simple* make the *Quintuple*? (like as their Exponents $4 + 1 = 5$.) And the like oft elsewhere. And 'tis that *Composition of Proportion*, οὐρασις λεγυς, which *Euclide* defines, in the *14. Def. of the 5 Book*; but different from that defined in the *5th Def. of the 6th Book*.

'Tis indeed an Inconvenience, that two so different Notions should, both, be called *Composition*; But 'tis very Ancient, and cannot be now helped. (For whatever remedy be applyed for the future, yet as to the Bookes already written, Ancient or Modern, that Ambiguity will remain.) But 'tis not hard (for one that is willing) to understand, in whether of the two senses the word is used by such or such an Author, in this or that Place. (And to remedy the Inconvenience, as much as might be, as to my own use of the

Word; I call the one (that of the 6th Book) *Composition by Multiplication* of the Exponents; the other (that of the 5th Book) *Composition by Addition* of the Exponents.

But Mr. *Hobs* findes no Inconvenience in it at all; but makes a great Advantage of this Ambiguity, *Pag.* 51, 52, 53, 87, 88, 116, &c. For, by this meanes, whatever is said of the One, he will be sure to interpret of the Other: and thereby furnish matter of discourse for *Thomas* and *Hobs*, to shew, That it is not true in that sense wherein it was never intended. And whether I say, *Composition by Addition*, or *Composition by Multiplication*, (the termes whereby Modern Writers use to distinguish those two Compositions,) he takes no notice of that at all. For still *Composition* is *Composition*; And *Composition* (what ever it be defined in the 5th of *Euclide*) is in the 6th of *Euclide* defined to be, by a *Multiplication of the Quantities*; And this is also *Addition*; For all *Composition* is *Addition*; for to *Add* is to *Put together*; (It seems he did not know that *Composition*, σύνθεσις, is a word common to *Addition*, and *Multiplication*; and that a Number made by the Multiplication of two Numbers, is *Numerus compositus*, and so defined by *Euclide*, 13 d. 7. And himself p. 52. and elsewhere, by *Quantitas composita*, doth mean the *Product of Multiplication*.) And to talk of any other *Addition* or *Composition* of Proportions, than that so defined, is *Wallisian* and *Hodiern*, (and had not *Euclide* been a *Wallisian*, he would not have mentioned any other.) *Clavius*, he confesseth p. 87. did so speak. But he was a *Jesuite*; and, he took pains for it: I ought not to follow him, and so easily. And by this Artifice he hopes at once to blow up, not onely what I had delivered about the two *Compositions of Proportion* (by *Addition* and by *Multiplication* of their Exponents) being the same with the *Addition and Multiplication of Fractions*; But my whole Doctrin of *Infinities*, because I there suppose that $\frac{1}{4} + \frac{1}{4}$ is equal to $\frac{1}{2}$ (a *Groat and Two-pence* equal to *Six-pence*, or *half a Shilling*;) whereas he thinks,

that

that the Compound of $\frac{1}{2}$ and $\frac{1}{4}$ must needs be $\frac{3}{4}$. (Which furnishes discourse for six or seven pages, p. 116, 117, 118, 119, 120, 121, 122.) And he *Wonders* much, That, not onely *Hugenius*, *Schootenius*, &c. should commend that *Doctrine*; but, *Robervall* lay claim to it (as, he sayth, his manner is) as an *Invention* of his, but never published. (But if Mr *Hobs* had been but half so good a Mathematician as the worst of them, he would have found as little fault with it as they did. Yet I suppose they do not *Wonder*, for 'tis no *Miracle*, nor thing unusuall, to see Mr *Hobs* argue at this rate.)

But his friend *Meibomius*, (who doth as little *Like* the *Doctrine* of *Exponents*, and this *Two-fold Composition*, &c.) doth, as to the *Antiquity*, differ from him. For whereas Mr *Hobs* takes it to be *Wallisian* and *Hodiern*; *Meibomius* (though against himself) cites to that purpose, of the Greeks, *Nichomachus Gerasenus*, *Heronas*, *Ptolomy*, *Porphyrius*, *Theon Smyrnaus*, *Theon Alexandrinus*, *Eutocius*, &c. and, of the Latines, *Redulphus Volumnius*, *Cardan*, *Clavius*, &c. (in his *Dialogue of Proportions*, pag. 16, 17, 22, 25, 30, 39, 79, 96, 99, 101, 127, 129, 130, 131, 161, 162, 165, 166, 167, 172, 186, 188, 190, & alibi.) and tells us p. 127, that these *modern errors* (so *Coherent* they are with the doctrine of the *Ancients*) cannot be refused, without first shewing, That *All Antiquity* was ignorant, of what Mr *Hobs* and He would have us take for *Truths*; (*viz.* Mr *Hobs*, for *Ancient Truths* which we *Hodierns* do not understand; *Meibomius*, for *New Discoveries*, which the *Ancients* never knew.) And whereas Mr *Hobs* tells us p. 87, that, notwithstanding the authority of *Clavius*, the contrary opinion hath obtained: *Meibomius* complains p. 167, that *Clavium secuta est tota Mathematicorum cohors ad nostra usque tempora*; And p. 172, 173, *Tanta autoritatis fuit Clavii opinio, ut hanc deinde loquendi formulam omnes Mathematici usurparint*; And p. 127, that, *Cum Theone, Juniores omnes*, were of the same opinion. And p. 165.

Quod Theo vult & Eutocius, omniumque juniorum Mathematicorum filii. But 'tis very possible, that Mr *Hobs* (so great an Enemy to reading of Books) might well be Ignorant of all this. But then he should (for the same reason) have been more sparing in Condemning as *Hodiern* and *Singular*, what others know to be so *Ancient*, and so *Universally* imbraced. (Unlesse he think it a credit, not to have Read any of those Authors.)

I shall not undertake here, to reconcile *Meibomius* and Mr *Hobs*, (either each to other, or to themselves.) But, leaving them to agree as they can, shall, before I leave this discourse of *Proportions*, give You this Brief Account of what hath been more at large discoursed.

That *Homogeneous Quantities*, (or *Quanta*; for I mean it, with Mathematicians, of the *Concretes*; not, as in Metaphysicks, of the *Abstracts*;) I call, (with *Euclide*) *Those which may, each of them, be so multiplied as to exceed the other.* Those which cannot, (as *Line*, and *Time*;) I call *Heterogeneous* each to other.

That such *Homogeneous Quantities*, are wont to be Compared; As to their *Difference*, which is found by *Subduction*; And, as to their *Ration* or *Proportion*, (Geometrical, I mean; not that which is called Arithmetical,) which is found by *Division*. The *Quotient* of Division (whether a *True Number*, or *Homogeneous* to it,) determining the *Quantity* of that *Proportion*; and giving *Denomination* to it. (As 2, to the *Double*; 3, to the *Triple*; $\frac{1}{2}$, to the *Subduple*; and 1 (not 0) to the *Simple*, or that of *Equals*; $\frac{A}{B}$, to that of A to B. &c.) Which is therefore called the *Quantity*, the *Denominator*, or the *Exponent* of the *Proportion*.

That *Ration* or *Proportion*, is the *Relation* of two *Homogeneous Quantities*, one to the other, considered as to the *Quotient* of the *Antecedent* divided by the *Consequent*.

That, the *Double*, the *Half*, &c. are *Rations* in the *Concrete*;

crete; *Doublenesse*, *Half-nesse*, &c. *Rations* in the *Abstract*, (and of *Metaphysicall* rather than *Mathematicall* consideration;) and 2 or $\frac{2}{1}$, $\frac{1}{2}$, &c. the *Exponents* of those *Rations*.

That, If the *Quotient* of one *Antecedent* divided by its consequent, be *Equall* to the *Quotient* of another *Antecedent* divided by its *Consequent*; the *Proportion* of that first *Antecedent* to its *Consequent*, is *Equall* to the *Proportion* of this other *Antecedent* to its *Consequent*: If greater, greater; If lesse, lesse.

That, the *Double* and the *Treble*, is the *Quintuple*; because $2 + 3 = 5$: The *Double* of the *Treble*, is the *Sextuple*; because $2 \times 3 = 6$: The *Duplicate* of the *Treble*, is the *Nonuple*; because $3 \times 3 = 9$. The first is a *Composition of Proportions by Addition of the Exponents*: The second, a *Composition of Proportions by Multiplication of the Exponents*: The Third, a *Composition of Proportions whose Exponents are Equall, by Multiplication of those Equall Exponents*; (And differs from the second, as a *Speciall*, from a *Generall*: viz. a *Composition of Two like proportions*, by multiplication of their *Exponents*, is the *Duplicate*; of *Three*, the *Triplicate*; of *Four*, the *Quadruplicate*, &c. to one of those like *Proportions*.)

That the first of these is the same *Operation* with the *Addition of Fractions*; The Second, the same with the *Multiplication of Fractions*; And the Third, the same with the *Squaring, Cubing, &c.* of *Fractions*. All *Fractions* (*Proper* or *Improper*) being no other than the *Exponents* of *Proportions*; Or, the *Quotients* of the *Antecedents* divided by their *Consequents*.

And with this *Account* of my *Doctrine of Proportions* (which I presume you will not take to be, either so much *Hodiern*, or *Unintelligible*, as to Mr *Hobs* it seems,) I will conclude what I have to say to his fourth *Dialogue*. For, to my *Treatise against Meibomius*, which he would seem there to consider, (that it might not be thought that any

piece of mine passeth unanswered,) he hath nothing further to except, but, That the *Epistle is too long*, and *too full of Symbols for him to understand*, and that *I therein cite twelve Verses out of Homer.*

In his Fifth Dialogue he pretends to confute Three other pieces of mine: That of the *Angle of Contact*; Of *Conick Sections*; and my *Arithmetick of Infinites*.

The Result of his Confutation amounts to this. That, in the First, *I have demonstrated what was undertaken*; The Second, *is so full of Symbols that he cannot understand it*, (and therefore it may be true for ought he knows;) The Third might be true also, if $\frac{1}{3} + \frac{1}{2}$ were equal to $\frac{1}{2}$, (a *Groat and two-Pence*, equal to *Half a Shilling*;) but, this being absurd, he *Wonders that other good Mathematicians should commend that piece.*

The first of these concerns a Controversy between *Peletary* and *Clavius*, concerning the Angle of Contact.]

Euclide had proved, 16 e 3. That the left Right-lined Angle possible, is Bigger than that which is called the Angle of Contact. (And it is allowed by all so to be.) But doth not expressly say whether the *Angle of Contact*, (as it is called) be indeed an *Angle* of any *Magnitude*.

Peletary is of opinion, That it is not; Nor, that it adds any thing to the Angle of a Semicircle. But, that the Angles of Semicircles, are all equall each to other, and to a streight-lined Right Angle. (That the Angles EAP, DAP, DAG, are all equall each to other, and to the Right Angle CAP.) And, that the Arch AE, and the Tangent AP, as to the Point A, are rather to be considered as *Parallels*, or *Coincidents*, than so *Inclined* as to make an Angle.

Clavius thinks otherwise. That the Angle of Contact is an Angle of some Magnitude, though lesse than any possible streight-lined Angle. That the Angle of the Semicircle CAE is not equall to the Right Angle CAP, but a
part

part thereof; the other part being the Angle of Contact EAP. That CAD, CAE, Angles of Unequall Semicircles, are unequall; as also the Angles of Contact EAP, DAP, DAG.



Now, in that Treatise, I take *Peletary's* part against *Clavius*.

And Mr *Hobs* grants the whole; That the Angle of a Semicircle CAE is not a Part, but the Whole, of the Right Angle CAP. (And he had sayd as much heretofore, *Corp.* c. 14. §. 16. An Angle of Contingence if compared with an Angle simply so called, which is the present case, hath such proportion to it, as a Point hath to a Line; that is, he sayth, no Proportion at all, nor any Quantity. Though, since, he hath been much offended with me, for saying A Point hath no Quantity. And, The Angle of Contact, as it is called, No magnitude. 'Tis equall, he sayth *ibidem*, to an Angle at the Center, made by AB and the same AB: now where the *Cura* of a supposed Angle, come so near as to be coincident, that supposed Angle contained by them, must needs be of no magnitude. And 'Tis equall, he says there, to an Angle whose Arch is the same point B; that is, I think, to an Angle of No-magnitude.) That the Angle of Contact, adds nothing to that of a Semicircle; He allows also. And, that Angles of Semicircles are All Equall, each to other, and to that of a Straight-lined Right Angle. He allows pag. 105. That I have sufficiently demonstrated, that in the Angle of Contact there is no Inclination; *Inclinationem in Angulo Contactus nullam esse, satis quidem demonstrat*: (though, in the next page, p. 107, forgetting this concession, he affirms the contrary; *Quin arcus & tangens ad se inclinentur, dubitari non debet.*) In summe; He grants, that the Angle of Contact is not an Angle simply so called, that is, not such a thing as *Peletary* or *Clavius* meant by Angle; nor, of any Magnitude,

Magnitude, as compared to such an Angle. (Imp *Idē* *Idē*.)

But had Mr *Hobs* stayd here, it might have been thought, that somewhat of mine had not been confuted. And therefore, rather than say *Nothing*, he will say *Nothing to the purpose*.

He tells us, that Though it be not that which *Euclide* (and other Mathematicians after him,) nor what *Peletary* and *Clavius* in that Controversy, call an *Angle*; nor any thing *Homogeneous* thereunto: (But so *Heterogeneous*, that it is not possible for one definition to comprehend both, and that it is but an *Equivocation* to call both by the name *Angle*, p. 40.) Yet, he says, it is an *Angle*, that is such a thing as He means by *Angle*, though not what others mean by that Word, (And he might as well have proved, that A Horse is an *Angle*: For, if he shall please first to Define, That, by *Angle* he doth not mean what *Euclide* calls *Angle*, but what others call *Animal*; he may well infer, That A Horse is an *Angle*, that is, an *Animal*, and of some *Magnitude*.) But was it not a great Errour, that none of us were able to prophecy, In what *New Equivocall sense*, Mr *Hobs* was afterwards to use the word *Angle*? and, apply our discourse in that Controversy accordingly?

Now, though it be no more to the purpose, in this Controversy, to talk of Mr *Hobs's Angle*, than to talk of a *Fishing-hook* (for that also is called an *Angle*;) Yet, since he doth so importunately intrude it, (for we have it in his Book of *Body*, Latine and English; In his *Lessons* at least twice or thrice; and as oft in his *Dialogues*;) wee'l consider a little, how he doth manage this his New Notion of *Angle*.

But first he finds fault with *Euclide*, p. 106. that in Defining an *Angle*, he speaks, *Vulgi more*; which he saies is very *Absurd*. (Yet, a while since he told us, 'twas very absurd not to do so, as you heard before: because 'tis not the Work of a Mathematician, to determine, What shall be thus called; 'tis the work of the *Vulgar* to impose Names.)

He

He thinks when *Euclide* saies that *Two streight lines* contain an *Angle*, that he takes an *Angle* to be a *Superficies*; (For *Euclide* tells us, *Axiom* 10, that *Two streight lines* Cannot contain a *Superficies*.) It seems when *Mr Hobs* doth so speak (and he doth so speak very often) he takes an *Angle* so to be.

He is then of opinion, That *two lines may make an Angle* though they never meet; For fear lest, if he should say, (with *Euclide* and others,) that an *Angle* is made by the concurrence of two lines, he must say also, that two *Points*, that is, two *Nothings* make an *Angle*: (For he had heretofore told us, that *A Point* hath no *Proportion* to a *Line*, nor any *Quantitie* at all, *Corp. cap. 14. § 16.* And again, *cap. 15. § 20*, as first printed, *Punctum inter Quantitates nihil est, ut inter Numeros Ciphra*; That, *As a Cipher in Numbers*, so a *Point in Quantities*, is *Nothing*. Though he will not allow me to say, that *A Point* hath no *Magnitude*.)

To the Argument, That, *If the Angle of Contact* be a *lesser Quantitie*, and the *Right Angle* a *Bigger*; (That, a *Part*; This, the *Whole*;) Then that may be so multiplied as to exceed this, (by 5 d 5, and 1 e 10.) When *Clavius* excepts, that the Argument doth not hold, because the *Quantities* are *Heterogeneous*: 'Tis replied, that *Clavius* making the one to be a *lesse Quantitie*, the other *Bigger*; and the one a *Part*, the other the *Whole*; he must, by 3 d 5. confesse them to be *Homogeneous*; and this *Whole*, if *Homogeneous* to one *Part* (that of a *Semicircle*, as is confessed,) must therefore be *Homogeneous* to the *Rest*, (the *Angle of Contact*.) *Mr Hobs* allows all this to be *True*, but not a good Argument against *Clavius*.

To another mistake of *Clavius*; when I said 'twas *False*: *Mr Hobs* confutes me, *pag. 109.* for not having said, that it was *Absurd*. (You may think perhaps, that he blames me for having said too little, thinking that to say, *It is Absurd*, is somewhat more than to say, *It is False*. But that is Your mistake. He thinks it is too much. For *Scaliger's*

Quadrature

Quadrature, which makes the 12 sides of a *Dodecagone*, greater than the Perimeter of the circumscribed Circle, he doth, in the same page, grant to be *Absurd*; yet he maintains it to be *True*, pag. 142.)

What he saies next, Of *Homogeneous*, making it the same with what others call *Commensurable*; Of *Numbers* not being *Homogeneous* save only when the things *Numbred* be so, &c. I say nothing now, because to this we have spoken already. But we'll come to his Explication of his New *Equivocal* notion (as he calls it) of an Angle. Which I promised but now, because of his importunity, to take some notice of. An *Angle of Contact*, he saies, is an *Angle*; and, an Angle of some *Quantitie*; but its *Quantitie Heterogeneous* to the Quantity of a streight-lined Angle; this being measured by a Circular, that, by a Streight line; which are, he saies, *Incongruent*; and, therefore, the Quantities, *Heterogeneous*.

I shall not here mind You of what was before maintained by him, that the *Quantitie* of any thing whatever, to the *Quantitie* of any other whatever, is *Homogeneous*, not *Heterogeneous*, (which might make it seem strange, how, of these two *Quants*, the *Quantities* should be *Heterogeneous*;) Nor, that a *streight line* is by and by to be found *Equal* to a *Circular*, (and therefore not *Heterogeneous*;) But, supposing all this to be forgotten, let us see what it is he aims at.

He first tells *Thomas* (and it is most true,) That a *Circular line is Crooked*. And *Thomas* doth confesse, It is so. He then tells him, that, of Crooked Lines, *some may be more Crooked than other*. Which *Thomas* also grants. He thence infers, *There be therefore certain Degrees of Crookedness*. And *Thomas* cannot deny it. He then observes out of *Galilee*, that *An Arch of a Lesser Circle is more crooked than an Arch equal thereunto in a Greater Circle*. Which when *Thomas* is content to grant, but, doth not understand, How this concerns the Angle of Contact: He tells him, That

That by the Quantitie of the Angle of Contact, he means, the Quantitie of Crookednesse of the Circular line. (*Disquantitatem Anguli Contactus, esse quantitatem Curvitatæ perimetri quam contingit.*)

So that, in saying An Angle of Contact is an Angle of some Quantitie, or Greatnesse, his meaning is no more, but that A Circular Line is Crooked: And in saying, An Angle of Contact is of So-much Quantitie, or is So-Great, his meaning is, that A Circular Line is So Crooked.

Now if this be all he means, I think we need not be difficult in granting, That a Circular Line is Crooked, and that it is So-Crooked, that is, that every Circular Line hath a certain degree of Crookednesse. But how this concerns the Controversie between Peletary and Clavius, I do not understand: For, I think, they did not differ about this point, Whether a Circular Line be Crooked? or, How Crooked?

But being, through his importunity, gone thus far out of the Way: we'll stay a while to consider, how well he states this Crookednesse, and the Quantitie of it.

How shall we know, how great is that Crookednesse, which he calls the Angle of Contact, as to this or that Circle? Suppose, AHL?

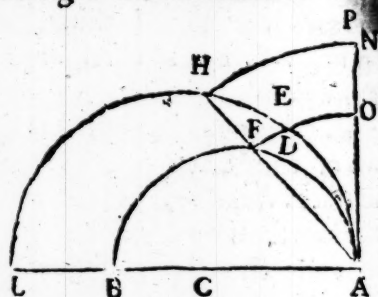
'Tis measured, he saies, by a Streight-Line, as such, (*linea recta quatenus recta*, p. 110.) And if we ask, by what streight-line? He tells us, pag. 41. *Angulus contactus mensuratur per Lineam rectam ductam a Puncto Contactus ad Circumferentiam.* 'Tis measured, he saies, by a streight-line drawn from the Point of Contact to (some other Point of) the Circumference, (for so, I suppose, he would have it supplied.) If you ask, To what other Point? He means it, I suppose, indefinitely, Any other Point. (For he doth not determine any.) Such therefore is the line AH, or AL. (And of such lines 'tis manifest he means it, pag. 111. and elsewhere.)

But what, must we say then? That the Crookednesse of the

the Arch AH, is equal to the streight line AH? and, that of the Arch AL to the streight-line AL? and, the Angle of Contact EAP equal to this, or that, or any other such line? Or, if not, What doth he mean in saying AH, or AL, is the *Measure* or the *Quantitie*, of that *Crookedness*, or *Angle*?

If you say, He adds there, *The greatnesse therefore of two Angles of Contact is measured by a streight line drawn from the Point of Contact through Both Circumferences*: (such suppose as AFH, or ABL.) 'Tis true he doth so adde; But this doth not answer my Question; For I did not ask, *How great are Two*; but, *How great is One Angle of Contact*? Or, *The Curvity of One Arch*? For he saith, *Angulus Contactus*, &c. One Angle is so measured.

I am loth to think he should mean (and yet there is no other meaning obvious, at least as to one Angle of Contact alone considered;) I am loth, I say, to think he should mean, That the *Angle of Contact* EAP, is equal to the *streight*



line AH; For (besides that it seems not congruous to say, that an *Angle*, is equal to a *streight-line*; as the thing Measured, is equal to its Measure;) he must by the same reason, say that the same Angle is equal also to the streight line AL, or to any other streight line drawn from A to any point of the Circumference; and consequently, that it is *Greater*, and *Lesse*, than it self. (For, that the Archs HA, and LA, do make the same angle of Contact with AP, I suppose he will not deny.) Nor, That the *crookednesse* of the Arch AH, is equal to the *streight-line* AH; For (besides the seeming Solœcism) he must, by the same Reason say, that the *Crookednesse* of the Arch AL, is equal to the streight-line AL. And, consequently, that the *Crooked-*

nesse

ness of the Arch AH, to the Crookednesse of the Arch AL, is as the *streight-line* AH, to the *streight-line* AL, (as the Chord of that, to the Chord of this,) Which, I think, he cannot in any sense affirm. (Or, if he should, the contrary will easily be evinced, from what he grants, p. 111. That, the *Curvities of like Archs is Equal*: and, therefore, the Curvity of the *Unlike Archs*, in the same circle, Proportional to those *Archs*, not to their *Chords*.) If You can tell any other tolerable sense, in which the *Positive* (not the *Relative*) Quantity of *One Angle of Contact* can be properly said to be *Measured*, by *One Streight-line*; You may oblige me by that discovery.

But, if You would have me lesse Severe as to this Demand; and to excuse him as to the *Angulus Mensuratur*, (the *Positive Magnitude of One Angle of Contact*,) if he can but give a good account of his *Anguli Mensurantur*, (the *Relative, or Comparative Magnitude of two Angles*;) I am content so to do.

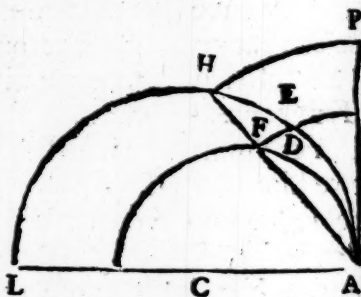
Yet I must say withall, That it is a favour more than we owe him. For, though that which his discourse tendeth to, be indeed an account of the *Comparative greatnesse, or Proportion, of Two Angles*; by two Proportional streight lines: Yet 'twas more than he was aware of. For he thought he had been determining the *Positive Greatnesse of One Angle*; (and doth pretend to have done it.) And therefore in his *Leçons* (from whence he doth but transcribe his Dialogues) pag. 3. After he had given this account of the *Angle of Contact's Positive greatnesse*; he proceeds to speak of the *How much Comparatively, or the Proportion of Two*, one to the other; as quite another thing.

And when we have allowed him this favour, he is not very happy in the managing his Notion, even as to the *Comparative greatnesse of two*.

For suppose we, first, the Quantity of the Angle of Contact EAP, or of the Curvity of the Arch AH, to be designed

designed by the Chord AH (as he directs, *Dial.* p. 41. *Angulus contactus mensuratur per lineam rectam ductam a puncto contactus ad circumferentiam*; and *Less.* p. 4. The Measure by which an Angle of Contingence is measured, is a straight-line intercepted between the point of Contact, and the Circumference of The Circle; that is, I suppose, of the Same Circle, not of another :) We are then (by the same directions) to design the Quantity of the Angle of Contact DAP, (whose comparative greatnesse to that other we are to consider,) by such another line so drawn from the Contact to the circumference; yet not drawn at pleasure (as that first was,) but by AF, a portion of that first line AH; (for so we are directed *Dial.* p. 41.) to the end that the Archs AH, AF, may be like Archs.

Now You may expect perhaps, that the Angle of Contact EAP to the Angle of Contact DAP; or the Curvity of the Arch HA, to that of the Arch FA; should be as the Chord HA, to the Chord FA, (the measure of that, to the Measure of this :) But 'tis far otherwise. For EAP



which Mr Hobs will have to be the Lesser Angle; and the Arch HA, which, he saies, is lesse Crooked; have the Greater Measure: (The Chord HA being manifestly greater, than the Chord FA, a part of it self.) And Mr Hobs himself confesseth it, *Dial.* p. 111. and *Less.* p. 3. And therefore he doth not say, As the Chord to the Chord, so the Curvities to the Curvities, respectively, or the Angle of Contact, to the Angle of Contact, (Which should have been the Proportion, if those had been the Measures of these :) But, As the Chord of the Greater Arch, to the Chord of the Lesser: so (contrarywise) the Curvity of the Lesser, to the Curvity of the Greater; and the Angle of Contact made by

by that, to the Angle of Contact made by this.

Those *streight-lines* therefore are not the Measures (as he pretends) of the *Curvities* of their Respective Archs, as to their *Positive* Quantities; Nor yet, as to their *Comparative* Quantities, the Proportion of Those, the Measure of the Proportion of These: (But the *Inverse* rather of that Proportion.)

So that, though there be a Truth in that Notion of *Galilee* (that Equal Archs are more Crooked in Lesser than in Greater Circles;) and none, that I know of, did ever doubt it: Yet Mr *Hobs* hath (unhappily) so mis-managed a good Notion, as not to Advantage, but rather Prejudice, himself by it.

But there is yet a greater Mischiefe: and that which strikes at the Foundation of what Mr *Hobs* would build upon it. The thing he aims at, is to prove, That the *Angle of Contact*, hath a *Positive Quantity*, but *Heterogeneous* to the Quantity of a *streight-lined Angle*. (For, unlesse *Heterogeneous*, he grants that it hath none at all.) But, why *Heterogeneous*? *Because* (he tells us, pag. 110.) *the Measure of a Streight-lined Angle is Incongruent with the Measure of an Angle of Contact*. But why *Incongruent*? *Because* *Angulus rectilineus non mensuratur per Lineam nisi Circularem, & quidem quatenus Circularem; mensura autem Anguli Contactus est Linea Recta quatenus recta*; That is, No Line but a Circular can measure a *streight-lined Angle*; and none but a *streight line*, the *Angle of Contact*. And upon this foundation lies the whole weight of his Discourse. (For if either Both may be measured by Circular, or both by *Streight Lines*; he hath then nothing to say, why, if Quantities, they are not *Homogeneous*.)

Now that *streight-lined Angles* may be measured by Archs of Circles, (that is, the Proportion of Angle to Angle, by the Proportion of Arch to Arch;) I grant: (though not by these onely.) But that the *Angles of Contact* (as he

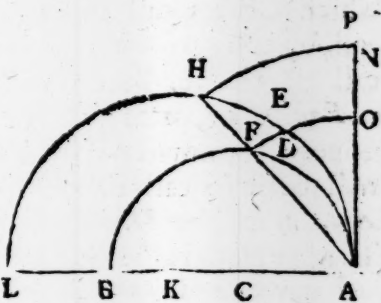
speaks) that is, the *Curvities of Archs*, (as he explains himself,) are measured by *Streight-lines*, as such, and by such only; I shall not grant him, nor can he evince. For if, as he affirms, the (Comparative) *Curvity of the Archs* HA, FA, (that is, the Proportion of those Curvities, or rather the Inverse of that Proportion,) be measured by the (Comparative) *Length of their Chords*, (that is, by the Proportion of those Lengths;) it will be as much measured by their *Own Lengths*. For, since that like *Archs* are proportional to their *Chords*; what ever Proportion is measured by that of their *Chords* will be as much measured by that of those like *Archs* themselves, (for 'tis the same.) They may therefore, as much, be measured by *Circular*, as by *Streight Lines*. Which destroys the Foundation of Mr *Hobs's* Discourse. Again, If on the Center A, we suppose Two Archs drawn from the points H, F, cutting the Tangent AP, in N, O. Those Archs HN, FO, will, as much as HA, FA, their Semi-diameters (because proportional to them,) measure the Respective Angles of Contact EAP, DAP. They may therefore as much be measured by the length of Circular, as of Streight Lines: And, Mr *Hobs's* Hypothesis comes to nothing.

But (to distinguish what Mr *Hobs* would confound) the *Angle of Contact*, and the *Degree of Curvities*, are not the same, but very different things.

'Tis very true, which Mr *Hobs* observes out of *Galilee*, that *Archs of Lesse Circles are more Crooked*. For, as the same Quantitie of Heat, in a Lesse Quantitie of Matter, makes a Greater Degree of Heat; or, as we use to speak, makes the Matter More Hot: So the Same Quantitie of Crookedness in a Shorter Line, makes a Greater Degree of Crookedness as to each part of it; Or, as we use to speak, makes the Line more crooked. And therefore, there being in Like Archs, though Unequal, the same Quantitie of Crookedness (as Mr *Hobs* acknowledgeth, p. 111.) there must be, in the Shorter of those Like Archs, a Greater Degree of Crookedness:

Crookednesse : (And the *Degrees* of Crookednesse, Reciprocal to the *Lengths* of those Like Archs.) But, whether we say, The Proportion of those *Degrees* of Crookedness, is Reciprocal to that of *their Own Length*; or, to that of their *Chords*; is all one (since the Proportion is the same of Both;) and Mr *Hobs* his conceit, of being measured by *Straight*, but not by *Circular* lines, is but a *Fansy*.

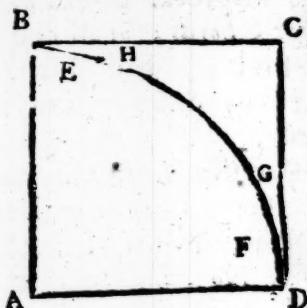
But the *Angle of Contact*, whether of Greater or Lesser Circles, is still the same; that is, of *No Magnitude* in either. For, since that the *Angles of Semicircles*, CAD, and CAE, be, by Mr *Hobs's* own grant, Both equal; and, equal to CAP; the *Angles of Contact* DAP, and EAP, must be likewise equal, and, of *no Magnitude*.



Or thus; The two Mixt Triangles, HEAN and FDAO, are *Like Figures*; For, all the sides of the One, being Like, and Proportional, and in like Position, with those of the Other; the Figures must needs be Like: (and Mr *Hobs*, I suppose, will not deny them so to be; or, if he should, 'tis easily proved from his own grants, by drawing the Semicircles HK, FC; for then these Triangles will be the Remainders of Like Quadrilaterals, abated by Like, Proportional, and Like-sized Sectors; and must therefore themselves be Like, Proportional, and Like-sized:) And therefore, (because, in Like Figures, the Respective Angles are Equal,) the Angles of Contact EAO, DAO, though of Unequal Circles, are equal Angles.

Or thus. The four Angles of a Square, are equal to four Straight-lined Right Angles. Now, if in the Square ABCD, be inscribed ABD the quadrant of a Circle; instead of those Four, we have Six Angles (if those of Contact

be reckoned for Angles,) equal to those Four; Those of the Quadrant at E and F, Mr *Hobs* grants to be equal to Two streight-lined Right Angles; and those at A and C, are two more: So that the Angles of Contact, at G and H, stand for Nothing, or Angles of no Magnitude. (I mean; If, by *Angle*, Mr *Hobs* mean that which Others call an Angle; and, by *Magnitude*, what they call Magnitude. But if he list to *Equivocate*, or to give Nick-names; they must be what he will please to call them. And, if by *Angle*, he mean an *Arch*; and, by *Magnitude*, *Crookednesse*; it is confessed, That an *Arch* is *Crooked*.)



I have deteined You too long in this Digression concerning *Crookednesse*; which, though not appertaining to the businesse in hand, the Importunity of Mr *Hobs* would needs put us upon. Otherwise, I need not have said more to what he saies of my Treatise concerning the Angle of Contact; but, that he grants all that I undertook to prove.

To my Treatise of *Conick Sections*, 'tis very little he hath to say, and will be satisfied with as short an Answer.

When I say that, according to the (now-received) Doctrine of *Indivisibles*; A Plain Figure is supposed to consist of Infinite Parallels, or Parallelograms of Equal Altitude; (and, in what sense, I had there shewed plain enough, beyond a possibility of mistake:) He will, by *Infinite*, understand *Ininitely Great*: (For, since that *Infinite*, in the Plural, doth sometime signifie, *infinitely Many*; and sometime, *infinitely Great*; Because he knew I meant the One, he thinks it a piece of Wit to interpret it of the Other.) Then, instead of *Aequo-altis*, he thinks fit to read *Aequa-*
libris,

libro, and discourse upon it ; (For want of Spectacles, I suppose ; not, with a design to Falsifie.) Then, he is not pleased that I should say, *An Aliquote part infinitely small ;* For *Aliquot* supposeth a *Number*, which *Infinite* excludes. (Yet he had just before blamed me for not saying *numero infinita* : And he had said himself, in the page foregoing, p. III. *in partes Totidem, quæ sunt numero Infinita* : It seems that *infinita numero*, may be *totidem*, but not *tot quot*, much lesse *aliquot*.) Then, he is of opinion, That if we suppose any Quantity, how big soever, to be divided into an Infinite number of parts infinitely small ; the Aggregate of all those parts is Equall to Nothing. (He doth not know, it seems, that an Aggregate of all the parts, whether few or many, is equal to the Whole.)

Next, he thinks I should have proved here ; And, pag. 155, 156, that I should have inferred else-where ; That, the Surface of a Cone, is, to the Surface of a Cylinder of the same Base and Altitude ; as 1, to 2. But I am not of his opinion ; For, the Proposition being False, ought not to be Proved, or Inferred, in either place. And the Reason why I did it not, is, because I do not love to argue like Mr Hobs. Nor do I think with him, that the Surface of either Cone or Cylinder, (more than the Perimeter of a Triangle or Parallelogram,) is determined by the Base and Altitude ; (though indeed the Content be both there and here so determined :) For, the Base and Altitude remaining the same, there may be yet infinite varieties of Surface there ; and of Perimeter, here : (as none, but Mr Hobs, can be ignorant.) But, if, for Altitude, he put *Latius* ; the Proposition will thus be true (and might have been affirmed in either place, though it were not necessary so to be,) viz. The Surface of an (Erect) Cone, is, to the Surface of Any Cylinder of the same Base and *Latius*, as 1 to 2.

Then he suggests a Limitation to my tenth Proposition, as if it were not otherwise true. But 'tis his mistake. The

Proposition needs it not. For the Section mentioned (without his limitation) can be no other but *Parabolical*. All Sections of a Parabolical Pyramidoeid, made by Plains lying in the Axis (though not passing by opposite angles of the Base) are Semi-parabola's, (whose common Vertex and Diameter, are the same with those of the Pyramidoeid,) but of different breadth according to their different positions.

He then tells me, (as though I had not known it,) That the *Cuneus* in my eleventh Proposition is (*he thinks,*) a *Prisme*. But 'tis no news, for I had first told it him at the same place. For it is there called *Cuneus sive Prisma*.

He then says, that *there may be taken* (and, doubtlesse, there may) *in the Diameter of a Parabola*, (yes, or in any other streight-line what-ever, if but long enough,) *a streight-line equall to the Parameter or Latuſ-rectum*. (But he should have shewed, That it cannot be any where else; if he would have proved, what he aims at, That the *Position* of the Parameter is as much determined, as the *Length*.)

The rest he summs up, with this generall Confutation, 'Tis full of *Symbols*; And, He cannot understand it. (Which I shall easily grant.)

I have repeated to you these particulars; Not, because I think they deserved an Answer, (for whosoever consults the places to which they refer, will see them to be but *Cavills*;) But, that You might thereby see, What kind of Discourse it is, which Mr Hobs accounts a *Confutation*.

- To my next Treatise, *The Arithmetick of Infinites*, (though that must be confuted too,) He hath yet lesse to say. For (beside that he cannot understand, how $\frac{1}{2}$ can be equall to $\frac{1}{3} + \frac{1}{6}$; of which we have spoken already;) it is but this.

The *First* Proposition, he sayth, is *True*. The *Second*, he

he sayth, is the Same with the First ; and, Therefore, False. (A good Consequence ! Yet *Less. p. 46.* he sayth, that Both are True.) But, to prove it false, he will take another time.

He is, next, of Opinion, that there cannot be supposed an infinite number of terms continually increasing, unless the Greatest be Infinite. (And yet he doth at the same time allow, That, in a Triangle, there are an infinite number of parallel lines so increasing, of which the Greatest is the Base.)

He then sayth, That *my Fifth Proposition*, (with its Consequents,) I do, at the thirteenth, *Confesse to be false*. But, if you consult the place, you will find no such Confession. The Proposition is true, with all its Consequents : so understood, as he knows it was intended. And his Cavils against it in his *Lessons*, have been abundantly answered ; *Due Correction, pag. 44.*

At length, He *Wonders* ; Why *Hugenius, Schooten, Robervall, &c.* should commend *my Mathematicks*, when as never any Mathematician commended His ? (The reason is, Because His, and Mine, are not alike.)

His *Universal Demonstration*, as he calls it, *p. 123*, is not worth the Confuting. Yet, because it doth not concern my self, I am content that Mr *Hobs* may believe it is a good one. Onely I have therein taken notice of one Advantage of Mr *Hobs* his writing Dialogue-wise, more than I did observe before. For, by this means, when *Hobs* hath occasion to Assume what he cannot Prove, *Thomas* can, by a *Manifestum est*, save him the trouble of attempting a Demonstration. And when the Demonstration attempted doth not succeed, he can relieve him, with a *Claritudinem per se tantam habet, Fere, ut possit haberi pro Axiomate*.

I have now done with his Five first Dialogues. Which are but his *Lessons* put into a new Dresse : And therefore do not indeed need an Answer : But were Answered before they were written.

His *Sixth Dialogue* is indeed most of it New, but doth little concern me; (as not being directed against any thing of mine;) But contains a new Effort, of his former Desperate Adventure, of *Squaring the Circle*. (For, it seems, His own *Mathematicks*, need *Emendation*.)

How many Quadratures, first and last, Mr *Hobs* hath furnisht us with; I cannot presently tell You. But that they are all true, and all the same, I suppose he would have us beleeeve. For though he have formerly confessed some of them to be mistakes; yet he hath now revoked those confessions, and thinks them to be true. pag. 149, 150, 159, &c.

His *First Quadrature*, *Corp. cap. 20. p. 169*, (as first printed,) or *p. 170*, (as afterwards) supposing the Radius 1.00000,00, makes the Perimeter 6.28385,11, *proxime*. (as I have computed it for him, *Elench. p. 102. according to his Construction*.) Whereas its true greatnesse is more than 6.28318,53, but lesse than 6.28318,54, as hath, by divers, been demonstrated.

His *Second Quadrature* (though he pretend it to be the same) *ibidem p. 171*. (as first printed) makes the Perimeter (as he computes it by the Table of Sines) to be 6.28317,60; or (more accurately) 6.28317,65, *ferè*. The former made the Perimeter too big; This, too little.

Instead of these Two (which he takes to be the same) we have pag. 170, (as reprinted) an *Epitome* of the First, but confessed to be false: For which therefore he there substitutes a Third, pag. 171, &c.

This *Third Quadrature* pretends not to an *Accurate*, but onely a *Quam-proximè*. (Nor is that, Truly performed; as we have shewed *Elench. pag. 119*.) nor doth he there conclude of any certain Proportion.

A *Fourth Quadrature* he gives us, *ibid. p. 174, 175, 176*. But, in the Construction, requires, as a necessary *Postulatum*, That we first know how to take a *Straight line equal*

to a Sixth part of the Perimeter: Without which, he can conclude nothing. And this also, pag. 181. is given for lost, as well as the three former.

A Fifth we have in his *English Edition*, p. 214. The result of which (reduced to Numbers) makes the Perimeter to be more than 6.28384,93. which is too big.

A Sixth, *ibidem*, p. 221. Which, though with him it passe for one, You may call as many as You please. For the Proportion varies, according as the Arch varies to which he applies his Rule; (which, he says, may be any Arch not exceeding a Quadrant.) As for example. If he apply his Rule to an Arch of 90 Degrees; the Perimeter will be more than 6.54353,39. If, to an Arch of 60 Degrees; it makes the Perimeter 6.42070,44, *proxime*. (Both very much too big.) And a like variety in other Arches.

A Seventh there is, at least attempted, *ibid.* p. 223. But it comes to no other issue, but this, *He thinks*, and, is almost out of doubt, but cannot demonstrate; that such a straight Line is equal to such an Arch; and will therefore leave it to be further searched into.

An Eighth, we have in his *Lessons*, p. 52. Where, pretending to make good his First, he gives us another instead of it. It differs from the first, in this, That the first, determining a particular Arch, (*viz.* BI an Arch of 30 Degrees,) did thereby at least determine some Proportion (though not the right, as was sayd before:) But This, not determining the Arch BI otherwise than that it be less than the Radius; leaves us at liberty to choose any such Arch: and so leaves the Proportion at as great uncertainty, as in the Sixth Quadrature. And so, instead of One Quadrature, it gives you (either None at all, or) as Many as You please. For, as the Arch varies, the Proportion varies too. As for example. If the Arch BI be 30 Degrees; Supposing the Radius 1.00000; the Perimeter will be more than 6.28385; If the Arch BI, be 15 degrees

degrees; the *Perimeter*, will be 6.28329. *proxime*. Both, too big. And the like variety in other Archs.

The four first of these I have at large confuted *Elench. p. 97. &c.* the latter four I have answered Sufficiently (though not so Largely) *Correction, p. 127, 128, and Disput. p. 11, 12.* and shewed them to be all False. But Mr *Hobs* doth not think fit to take any notice of that at all: And therefore tells *Thomas, Dialog. p. 149, 150.* that *Tacent adversarii*; and thence concludes, those Quadratures to be all *True*, and all the *Same*, with what he there delivers in his sixth Dialogue. But I shall not therefore think it necessary, to Confute them over again: Nor yet to spend much time on those that follow, in his Dialogues.

His *Ninth Quadrature, Dial. p. 142.* concludes (with *Joseph Scaliger*) that *Perimeter potest decem diametros*: Which, supposing the *Radius 1.00000,00.* makes the *Perimeter*, more than 6.32455,53; (which is, indeed, lesse than 6.28318,54.) 'Tis, he confesseth, inconsistent with what *Archimedes* pretends to demonstrate; and, after him, *Clavius* against *Scaliger*: Yet would not have *Thomas*, thereupon, discouraged; because he hopes to confute them all. And tells us, that, *if he do not clearly Demonstrate to him* (and 'tis a great attempt) *Arithmeticos Cyclometras omnes hac in re deceptos esse*, he will give him leave to think as *Clavius* and others do; and, to speak his pleasure.

The grand mistake (for I do not intend to trouble you with all the lesser faults) in the long proceſſe of this Quadrature, lyes in the *twenty fifth Proposition*, (which is it self *False*, and the three which follow it.) His *Quod est impossibile*, in the Demonstration, is a mistake. And his proof of it, is wholly inconſequent; viz, *Nam, cum sit, ut arcus et ad rectam μ , id est, ad arcum ν , ita arcus ν ad rectam σ ; media proportionalis inter arcum μ & rectam σ , erit ea recta qua media est inter μ & σ .* That is, *Because*

ed, is to $\mu = n^2$, as n^2 to σ ; Therefore, the Mean-proportionall between $\epsilon\theta$ and $\sigma\tau$ will be the same with the Mean-proportionall between μ and σ . Which consequence is so grosse, that it needs no Confutation. He should rather have concluded, therefore the Mean-proportionall between $\epsilon\theta$ and $\sigma\tau$ is n^2 or μ ; which is no Inconvenience at all, and therefore doth not prove the Supposition Impossible.

You might think perhaps (to help salve the Consequence) that he might have, before, somewhere proved, that n^2 is a mean-proportionall between μ and σ : But there is no such thing any where proved, or so much as mentioned, save onely in the words cited.

Again in the Demonstration of Prop. 26. those words lin. 15. *Erit ergo ut $\frac{1}{2}$ Radius ad arcum fg ita $\frac{1}{2}Z$ ad arcum $\xi\omega$* ; are not proved at all (unlesse he suppose that they follow from the precedent proposition, which is it selfe false:) nor are they true. 'Tis true, that the straight-line $\chi\downarrow$ bears such proportion to the Arch $\xi\omega$; but, that $\chi\downarrow$ is the same with $\frac{1}{2}Z$ or equall to it, is not true; nor, what depends upon this supposition.

And therefore this ninth Quadrature (prop. 27.) which depends upon the truth of those two, prop. 25, 26, is false also. Nor is it consistent with what Archimedes demonstrates, as himselfe confesseth,

He doth then, from this Quadrature, (how truly, I will not dispute) infer prop. 28. (which he thinks to be a Confirmation of it, I should rather call it a Confutation,) That, the Radius together with the Tangent of 30 degrees, are equall to BF; (whose Square, he sayth, is equall to 10 Squares of the Semiradius.) Wee'l try.

Suppose the Radius to be

$$1R$$

BF will then be

$$\frac{1}{2}R\sqrt{10}.$$

The sine of 30 degrees

$$\frac{1}{2}R$$

The sine of its Complement,

$$R\sqrt{\frac{3}{4}}, \text{ or } \frac{1}{2}R\sqrt{3}.$$

Therefore, As $\frac{1}{2}\sqrt{3}$, to $\frac{1}{2}$; so is R to ?

the Tangent of 30 degrees

$$\frac{1}{\sqrt{3}}R, \text{ or } \frac{1}{2}R\sqrt{3}.$$

But

But this Tangent added to the Radius, (sayth Mr *Hobs*) is equal to BF; that is $1R + \frac{1}{2}R\sqrt{3} = \frac{1}{2}R\sqrt{10}$. (An Irrationall line equal to a Rationall.) Which is the result of his Quadrature. But whether it Confirm or Confute it, I shall leave to you to judge.

His Tenth Quadrature, supposing the Radius to be 1,00000, makes the Perimeter more than 6,30940, (which is, in truth, lesse than 6,28319.) For so much is the Quadruple of BF, a line which is to the Radius, as $\sqrt{3+1}$, to $\sqrt{3}$. For, by construction, as $XA=R\sqrt{3}$, to $AD=R$, so is $XAB=R\sqrt{3+R}$, to BF: which Mr *Hobs* tells us, *prop.* 39, is equal to the Arch of a Quadrant.

The grand mistake of this Quadrature lyes in *Prop.* 34, 35. For having *prop.* 33. taken *BLa*, double to BL; he doth *prop.* 34. take for granted (which he should have proved) that the Point *a* lyeth in the line XDF: whereas, indeed, it lyeth beyond that line; and, consequently, the line *al* lyeth not in the line XDF as he supposeth; nor is XD a part of *la*, but parallel to it; therefore the point *a* falls not upon X, as he would prove, but somewhat below it: nor doth the line *al* come at all at D, nor the line DF come at all at *a*. So that his pretended Demonstration, which supposeth all these things, comes to nothing.

And that which follows, *prop.* 35. shews onely how good Mr *Hobs* is at Adding Surd Numbers. For he there affirms that *Recta quæ potest Tres Semiradios, assumpta quarta parte Diagonalis (sive Subtensa graduum 90,) poterit Sex Semiradios*. That is $\frac{1}{2}R\sqrt{3} + \frac{1}{2}R\sqrt{2} = \frac{1}{2}R\sqrt{6}$, (an Irrationall Line equal to a Rational; as once we had before.) Yet this he undertakes to demonstrate too. But, in the Demonstration, his *Quod est absurdum*, is a mistake. And, what he brings to prove it, *For sh sh cannot be parallell*, is very True, but is Nothing to the purpose. He should have sayd (to prove what he intends) that sh it cannot be parallell; But this he says not, nor is it true; and there-

fore

fore no Absurdity proved in the Supposition; Nor doth the line *tr* in true construction (however Mr *Hobs* have pleased to draw it) come at *s* at all; but, is parallell to *hs*.

And, *prop.* 36. which depends on them, is false also. And what is brought for proof, viz. $\lambda b \text{ potest } 24 \text{ Semiradios}$, (that is $R\sqrt{3} + R\sqrt{\frac{1}{2}} = \frac{1}{2}R\sqrt{24}$.) is but like the rest.

And *prop.* 38. is also false. The Demonstration failes in that clause *pag.* 148. *lin.* 13. where 'tis sayd that, *the two Archs described, one by the Radius AB, the other by the Radius no, cut each other (in medio rectæ lm) just in the midst of the line lm*; which is not so. They cut indeed each other, but not just in the middle, but over the middle of that line.

And consequently his Quadrature *prop.* 39. built upon these Props, falls with them: (Notwithstanding the Approbation which *Thomas* gives him, *p.* 149. *Absque dubio ita est. Aequalis est exactissime.*) And therefore he needed not have taken the pains to Apologize *p.* 149, 150. for Retracting his First Quadrature; which both *Thomas* and *Hobs* do now beleieve to be True, and the same with this; (though mistaken in both; 'Tis neither True, nor the Same;) and that therefore 'twas unadvisedly done to retract it. 'Twas his Modesty, he tells us, to suspect his own Demonstration, rather than *Archimedes's*, when he saw that Both could not consist. But, having now conquered that Modesty, he doubts not to Assert his own for truth; and, that *Archimedes*, with all that follow him, were mistaken. And herein, he hath (he tells us) an advantage, even over *Joseph Scaliger* himself; For *Scaliger*, having once quitted his Quadrature, did never after resume it; but Mr *Hobs*, (a person of greater Courage) hath dared (*quam abjecerit resumere*) to swallow a second time, what he had once cast up.

But having thus triumphed not over *Archimedes* onely, but *Joseph Scaliger*; he proceeds further to satisfy *Thomas*.

mas; Who, though he do now no longer doubt but that Both are true, yet is not satisfied that the Ninth and Tenth Quadratures do both Agree upon the same Proportion. ●

He therefore undertakes to prove, *Prop. 40.* that BF (which is to the Radius AD, as XA increased by the Radius AB, is to the same XA, whose square by construction is Triple to the Square of the Radius) *potest decem semiradios* (is equal in power to Ten squares of the Semiradius;) that is, that $\frac{\sqrt{3+1}}{\sqrt{3}}R$, or $R\sqrt{\frac{4}{3}}$, is Equal to $\frac{1}{2}R\sqrt{10}$. But in his first Demonstration of it, his *Dividit Ergo, &c. pag. 150. l. ult.* is no good consequence; and therefore 'tis not proved that $\angle xq\mu$, $\angle bq\xi$, are equal angles; nor, what he infers from it, that $XB (= R\sqrt{3} + R)$ *potest 30 Semiradios*, or is equal to $\frac{1}{2}R\sqrt{30}$. In his second demonstration, his *Quare omnes anguli, &c.* is no good inference.

There be yet two Difficulties, *pag. 151, 152.* which make Thomas begin to question whether somewhat be not amisse in Hobs's Demonstration; (till Hobs by a *Ne metue*, delivers him from that fear.) First he observes that the *Arithmetical Calculation doth not agree with his Geometrical proceffe*. For whereas he pretends to demonstrate that the Square of BX, that is, of $R\sqrt{3} + R$, or of $\frac{1}{2}R\sqrt{12} + \frac{1}{2}R\sqrt{4}$, is equal to 30 squares of $\frac{1}{2}R$ the Semiradius; 'tis yet confessed, that the Product of $\sqrt{12} \times \sqrt{4}$ multiplied into it self produceth indeed somewhat more than 29, but lesse than 30. (And the like in some other calculations.) Next, he thinks it to be an inconvenience, that the straight-line $X\sigma\tau$, should Cut at σ , and Touch at τ , the same Circle.

Now because it is very possible that your self may doubt, as well as Thomas, that Hobs's Demonstration (attended with these two Inconveniences) may not be every way Exact; I shall give you his own Answer; (For, I doubt, none but himself can answer those Objections.)

He tells him, therefore, It is but a *phantasia*, a bewitching
 fancy that possesseth some men (who know not how to
 allow a Point or Line, bignesse and breadth enough) to
 think that (Mr Hobs's) *Geometrical Demonstrations*, ought
 to abide the Test of an *Arithmetical Calculation*. But he
 hath a *Savva* before which this *phantasia* will never
 be able to stand. His *Lines*, he tells him, are not like the
 Lines of other men, (things of no Breadth or Thickness,)
 but carry some Breadth with them: So that while the
 Inner-side of his Line Cuts the Circle at σ , the Outer-side of
 it, Touches the same Circle at τ : For so he tells us, pag. 152,
 154. *Eadem ergo recta tanget circulum eundem in τ , &
 secabit in σ* . Which would be Absurd, he saith, had not
 the Line some Breadth. *Non est ergo recta $X\sigma\tau$ sine latitu-*
*dine, per quam possit latus eius exterius Circulum Tangere, &
 latus interius Secare eundem Circulum*. 'Tis, he confesseth,
res Mira, Stupenda, Prodigiousa, Nay more, *Acutissima quidem*
sed tamen Vera; and 'tis a truth *quam Primus docuit nos*
Hobbius; (he might have said *Solus*;) the Ignorance of
 which *Prodigious Truth*, was the cause, he tells us, why *Hu-*
genius, Schooten, Roberval, &c. did not discern those errors
 in my Writings, which Mr Hobs thinks he hath disco-
 vered.

I shall not detain You in reciting the Consequences
 which He doth infer from it, That the Tangent of a small
 Arch, may be lesse than the Arch it self, pag. 154, (and
 consequently, The Perimeter of a Circumscribed Polygon,
 Lesse than the Circumference of the Inscribed Circle:)
 That *Archimedes* was mistaken, in confining the Proportion
 of the Circumference to the Diameter, within the Limits by him
 assigned, p. 155. That Geometers have been all mistaken in
 Computing the Canon of Sines, Tangents, and Secants; pag.
 156. (With others of the like import.) Because You
 will easily believe, that this Discovery must needs
 be attended with a Numerous train of such Conse-
 quences.

But

But I am now satisfied, that it was necessary for Mr *Hobs*, whatever other men do, to allow his *Points* some *Bignesse*, and his *Lines* some *Breadth*; (Because, otherwise, his Paralogisms would never passe for Demonstrations.) For he that shoots at Random, if his Mark be not somewhat Large, is not like to Hit it. I shall onely desire him, by the Next, to tell me *How much* Breadth will serve his turn. For, if his *Lines* be not *Broader* than *Cheap-side*; I will undertake yet to demonstrate, that, notwithstanding this allowance, his *Quadratures* will not hold.

His *Eleventh* Quadrature (which yet remains) is indeed (though the Tenth be not) as to the Proportion of the *Radius* to the *Perimeter*, the same with the *Ninth*: (Which is a Wonder; for hitherto we have not had any Two agree upon the same Proportion.) But *prop. 43.* and *44.* (on which it depends) are both false.

The Demonstration of the former, concludes *pag. 157. lin. ult. Quare arcus op & recta AO sunt inter se Aequales, ut & arcus hi & recta BQ.* (Which was indeed to be proved, but doth not follow from the premisses.) Whereas all that can be inferred is this, That, *The Arch op to the streight-line AO, is (not Equal, but) in the same Proportion, as the Arch hi to the streight-line BQ.*

In the Confectary hereof, he assumes *gratis*, That the *Right-line nq* is equal to the *Arch op*. Or, if he suppose this to follow from *prop. 24.* we have found that false already.

And *prop. 44.* depends on *prop. 43.* (for it assumes from thence, that the *streight-line AO, is equal to the Arch of a Quadrant whose Radius is BQ:*) and therefore falls with it.

If these *Quadratures* be not enough; he gives us (unawares) a *Twelfth* Quadrature (to make up the Dozain) *prop. 45.* (though he take it to be but a Confirmation of the Tenth.) His Tenth Quadrature, drawing *XF* by a certain Point *D*, did determine a certain Proportion, (which

what

what it is, you have heard already) of the *Radius* to the *Perimeter*. But no v, drawing $X\beta$ by γ , any Point taken at pleasure in the Arch BL , he determines no proportion at all; but as the Point varies, so the Proportion varies too. I'll give but an instance or two.

First, suppose γ at L , and therefore δ at b . Then, As $XAb = R\sqrt{3} + R\sqrt{\frac{1}{2}}$, to $bL = R\sqrt{\frac{1}{2}}$, so is $XAB = R\sqrt{3} + R$, to $B\beta = \frac{\sqrt{3+1}}{\sqrt{6+1}}R$, which, he saith, is equal to $B\gamma$, that is BL , the *Semiquadrantal Arch*; And therefore $\frac{\sqrt{3+1}}{\sqrt{6+1}}8R$, to the whole *Perimeter*.

Again, suppose γ at S , and therefore δ at e . Then, As $XAe = R\sqrt{3} + \frac{1}{2}R\sqrt{3} = \frac{3}{2}R\sqrt{3}$, to $eS = \frac{1}{2}R$, so is $XAB = R\sqrt{3} + R$, to $B\beta = \frac{\sqrt{3+1}}{3\sqrt{3}}R$, which, he saith is equal to $B\gamma$, that is BS , an Arch of 30 degrees; And therefore $\frac{\sqrt{3+1}}{\sqrt{3}}4R$, to the whole *Perimeter*. (Which is the case of the *Tenth Quadrature*.)

Again, Suppose γ at c , and therefore δ at l . Then, As $XAl = R\sqrt{3} + \frac{1}{2}R\sqrt{2+\sqrt{3}}$, to $lc = \frac{1}{2}R\sqrt{2-\sqrt{3}}$, so is $XAB = R\sqrt{3} + R$, to $B\beta = \frac{\sqrt{3+1}}{2\sqrt{3+\sqrt{2+\sqrt{3}}}}R\sqrt{2-\sqrt{3}}$. Which, he saith, is equal to $B\gamma$, that is Bc , an Arch of 15 degrees; And therefore $\frac{\sqrt{3+1}}{2\sqrt{3+\sqrt{2+\sqrt{3}}}}24R\sqrt{2-\sqrt{3}}$, to the whole *Perimeter*. And the like variety in other cases.

Which if we reduce to Numbers; Supposing the Radius, 1,00000. The first makes the *Perimeter*, 6,33613, *fere*. The second, 6,30940⁺. The third, 6,29011, *fere*. (All, too big.) And every new Point gives a new Proportion.

You have now an account of his *Twelve Quadratures* at least, (though the *Sixth*, *Eighth*, and *Twelfth*, which may stand for as many as You please, passe but for One a piece;) and, Howw ell they agree.

And Now (saith Thomas) What will they say of Hobs, who have Reproached him hitherto? I'll tell You what they say. They say, that Mr Hobs is such another Geometrician as Joseph Scaliger. And this, I hope, he will not take to be a Reproach; for pag 75, 76, he accounts it a credit to be joyned with such company.

If You would have me now to give You a Particular Confutation of each at large; You do not consider, First, How great a Task You put upon Your self: For You would be then obliged, in civility, at least to Read them over; which were to put You to expense of more Patience (in reading the Confutation of so many weak mistakes, as we must needs meet with) than the Demonstration of this Proposition, *That Mr Hobs is no Geometer*, would be worth: Nor, secondly, How hard a task You impose on me. For (beside the expense of more time than the Subject doth deserve) it were the same as to bid me hold an Egg by the Tayle. *Quo teneam nodo?*

If, by a Confutation, You mean such as All but Mr Hobs, would account a Confutation; the Task were easie; and, 'Tis done already. But, if such as might perswade Mr Hobs to think himself confuted, *Id est confutatus*: You must first find me a Footing where to stand.

For if, first, I should say, 'Tis done already; while (to save you the labour of examining all his numerous Propositions) I have pointed to (some of) the most material and fundamental mistakes in the Demonstration of his several Quadratures; and, shewed you where he takes for granted what is neither Proved, nor True; (which most men would take to be a sufficient Confutation of a pretended Demonstration:) He would say, that 'Tis no Demonstration, *to Deny a Consequence, or Proposition, and Say, It is not Proved; Nor so much as any proof attempted.* I should Prove that it is not proved; as *Lesson. p. 35.* (else I do but *run on without an Argument. p. 41. &c.* and *Dial. Phys. p. 35.*) That is, I should light

light a Candle at midnight, to shew a blind man, that the Sun doth not shine.

Or, secondly, should I *Prove* that it is not proved, nor possible so to be, Because Inconsistent with what hath been demonstrated by *Archimedes* long ago, by *Clavius* against *Scaliger*, by *Snellius*, *Culen*, and others: (and was therefore confuted before 'twas written.) This would be no Confutation. For this he confesseth to be True; But *Archimedes* he tells us, was mistaken, and all that follow him, *Dial. pag. 142, 149, 150, 155, 178, &c.*

Or should I, thirdly, by a new Demonstration, prove again, what they had proved before; and which he grants to be inconsistent with what he affirms: He would say the same of this, as he doth of their Demonstrations; They are all mistaken, and so am I. (An easie way of answering demonstrations!) For, his Demonstrations being all good, what ever is or hath been, or shall for the future be said to the contrary, is not, he tells us, *Refutatio*, but *Refutatum*. *Dial. Phys. pag. 35.*

Or should I, fourthly, argue from what he grants, (in his *Philosophie of Bodies*, in English, *pag. 213.*) that *Archimedes* hath demonstrated the Perimeter of a Circle to be lesse than $3\frac{1}{7}$ of the Diameter, but more than $3\frac{1}{7}\frac{10}{7}$; or that, supposing the Radius to consist of 1000 equal parts, the Arch of a Quadrant will be more than 1570, but lesse than 1572 of those parts. And that *Snellius* and others have from true principles pronounced, That, supposing the Radius 10000000, the Arch of a Quadrant differs not one whole Unite from the number 15707963. Whereas, according to his Quadratures, it must differ from it by many Thousands. His Answer's ready; *Who knows but that, though their Principles be true, there may have been some Errorr in their Arithmetical Operations.* *ibid. p. 214.*

Or, fifthly, should I argue from the Canon of Sines, Tangents, and Secants, or the Foundations of that Canon. He tells us, that Geometers have been all mistaken in that

Canon; and did not in the Computation of it proceed upon right principles, or Geometrical Demonstrations. *Dial. pag. 156.*

If, sixthly, I should reply, That the *Foundations* of this Canon, are the same with those, which but now we heard him affirm to be *True Principles*, from whence *Snellius*, &c. demonstrate the Proportion mentioned. He will not stick to Answer, 'Tis true he Then thought them to be *True Principles*, but is Now of another mind. *They were all deceived.* pag. 142.

Or, seventhly, should I argue from what himself infers; That, by his doctrine, the Tangent is made lesse than the Arch; and, consequently, the Perimeter of a Circumscribed Polygon, lesse than that of the Inscribed Circle. He tells us, 'tis no Absurdity to Affirm, that the *Tangent of a small Arch may be lesse than the Arch it self.* pag. 154.

If, in the next place, I should say, That, if his Quadratures be right, 'tis very strange that *No one Mathematician* can be found who thinks so beside himself. He tells us, *The Reason is, Because He is alive.* *Dial. Phys. Epist.* (And it is not likely that *Two men* should be of that Opinion, in *One age.*)

If, ninthly, I should argue, from his own Authority; That *Scaliger's* Quadrature, he confesseth to be *False*, and a great Errour, *Less. p. 39.* and calls it *Absurd*, *Dial. p. 109.* which in the same book, *pag. 142,* he confesseth to be the same with his, and affirms to be *True*. And, that those of his own, which he now affirms for good, he did formerly confesse to be *False*. He tells us, *pag. 149, 150.* 'Tis true he did so: But 'twas his Modesty (*out of his respect to Archimedes,*) so to do; (as *Joseph Scaliger* had also done before him :) But, that he hath since corrected that fault, (which *Scaliger*, he tells us, *never did;*) and therefore is not now to be concluded by *Archimedes's* Numbers, *pag. 142, 150, 155, 159.*

Tenthly,

Tenthly, If I should shew, That of all his Twelve Quadratures (the ninth and eleventh onely excepted) there are not any Two, agreed upon the same Verdict. He tells us, That, to dis-believe his own Quadratures, because of some small *insensible differences*, nay though the differences were very sensible, were to dis-believe his own senses; pag. 159.

If I should then argue, from what himself confesseth, pag. 151, 152, &c. That what he delivers is not agreeable to Arithmetical Calculation. As for instance; That $\frac{1}{2}\sqrt{3} + \frac{1}{4}\sqrt{2}$ is equal to $\frac{1}{2}\sqrt{6}$, prop. 34, 35. That $\sqrt{3} + \sqrt{\frac{1}{2}}$ is equal to $\frac{1}{2}\sqrt{24}$, prop. 36. That $1 + \frac{1}{2}\sqrt{3}$ is equal to $\frac{1}{2}\sqrt{10}$, prop. 40. That $\frac{1}{2}\sqrt{12} + \frac{1}{2}\sqrt{4}$, or $\sqrt{3} + 1$, is equal to $\frac{1}{2}\sqrt{30}$; and $\frac{1}{2}\sqrt{16} + \frac{1}{2}\sqrt{5}$, or $2 + 2\sqrt{\frac{5}{2}}$, is equal to $\frac{1}{2}\sqrt{40}$. (Which he demonstrates for me, pag. 152, 153. to be impossible.) His Answer is, That no man, who is not bewitch'd, will think it necessary that (his) Geometrical Demonstrations should agree with Arithmetical Calculation, pag. 151, 152, 153. And, *Dial. phys.* pag. 37. that it is not meet, to examine Geometrical Problemes by Algebra, or Arithmetical Calculation.

If therefore, in the twelfth place, I should wave Numbers, and betake my self to Lines: And shew how he doth, very absurdly, make the same streight-line, to Touch a Circle at one place, and at another to Cut it. He tells us, pag. 152, 154. That 'tis no Absurdity, to say that the same streight-line doth with its Out-side Touch at one place, and at another place Cut with its In-side the same Circle.

If, then, I should urge Euclide's authority: who prop. 16. lib. 3. doth Demonstrate, That the Tangent Line lies all Without the Circle, and therefore cannot Cut it. He will tell me, 'Twas a mistake in Euclide, not to allow his Lines Breadth enough, prop. 41. The Ignorance of which Truth, (*quam primus docuit Hobbius*) was, he tells us, (in Euclide, as well as Archimedes,) the Mother of many Absurd mistakes, pag. 155. So that, You see, He will no more be bound

bound by *Euclide's* (slender) *Lines*, than by *Archimedes* his *Numbers*. (Nothing [redacted] can hold him; a *Line* of *some Breadth and Thicknesse*.)

If, after all this, I might hope to fasten on the 10th of *Euclide*, a place yet unfoiled: (For, though he think, it *was written to no purpose*, nor can any use be made of it; yet he doth not deny but that it is all *Accurate*, pag. 53, 54.) I would shew him, that, if it will serve for no other use, 'twill serve at least to confute his *Quadratures*.

He affirms, *prop. 40, 41.* that XAB , (the Aggregate of AB the Radius, and of XA equal in power to 3 Squares of the Radius,) is equal in power to 10 Squares of the Semi-radius: That is, $R\sqrt{3} + R = \frac{1}{2}R\sqrt{30}$. Against which I thus argue. Let R be the *exposed Rational*; Then (by *def. 2, 3.* or *prop. 8, 9. lib. 10. Euclid.*) $R\sqrt{3}$, and $\frac{1}{2}R\sqrt{30}$, are *Rationals commensurable in power only*, to the exposed rational R , and each to other. And therefore (by *prop. 36.* in the Greek Edition, or *prop. 37.* in *Clavius*.) $R\sqrt{3} + R$ is *Irrational*. But, (saith Mr *Hobs*) $R\sqrt{3} + R$ is equal to $\frac{1}{2}R\sqrt{30}$, (an *Irrational*, to a *Rational*;) Which is Absurd. And in like manner we may conclude against what he farther affirms, *prop. 28, 34, 35, 40, 41, &c.* viz. $R + \frac{1}{2}R\sqrt{3} = \frac{1}{2}R\sqrt{10}$, $\frac{1}{2}R\sqrt{3} + \frac{1}{4}R\sqrt{2} = \frac{1}{2}R\sqrt{6}$, $R\sqrt{3} + R\sqrt{\frac{1}{2}} = \frac{1}{2}R\sqrt{24}$, $2R + 2R\sqrt{\frac{1}{2}} = \frac{1}{2}R\sqrt{40}$. and more to the same purpose. But to this he would say, 'Tis so full of Symbols it cannot be understood; And, No man is bound to take my Symbols for Demonstrations. As *Lesson. p. 22, 23, 28, 35, 49, 53, 54, &c. Dial. p. 100, 105, 115*, and oft elsewhere.

If therefore, in the last place, (to avoid the Reproach of *Symbolography*) I should, in the Margin draw so many *Lines*, marked with such *Letters*, (for then the *Letters* will no more be *Symbols*, than so many *Letters* in *Euclide*;) and proceed as before. As for the Example, Let the line R , or AB , be an *Exposed Rational* equal to the *Radius*; and $R\sqrt{3}$, or XA , be equal in power to 3 Squares of *Radius*.

and therefore, by 8, 9, & 10. a Rational commensurable in power only, to the exposed

Rational R or AB: and consequently (by 37 & 10) $\sqrt{R^2 + 3R}$ X $\frac{1}{2}R\sqrt{30}$ A B
 $\sqrt{R^2 + 3R}$;
 (the Aggregate of both)
 an Irrational Line: Again

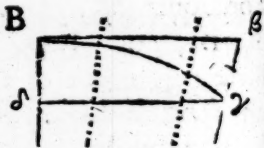
let the line $\frac{1}{2}R\sqrt{30}$ be equal in power to 30 squares of the Semiradius, or of half the exposed Rational R; which is therefore (by 8, 9, & 10.) a Rational commensurable in power. But that Aggregate, saith Mr Hobs, is equal to this Line; (an Irrational, to a Rational;) which is Absurd. To this I know not yet what Answer he will make: Whether he will tell us, as pag. 159. that so small a difference should not break squares; Or, will think fit to retract, what he before granted, pag. 53. that Euclide's Tenth book is Accurate; (For to complain of Symbols, or of Arithmetical Calculation, or of Ludolphine Numbers, there will be no cause; for here is nothing of all these:) Or, what other Answer he will think upon. Nor am I solicitous what it will be: But if Thomas and Hobs can satisfy one another; I think You and I are satisfied already, what to think of it.

I thought, not to have troubled You with the Consequents which he infers from those false Quadratures: About Dividing an Arch in ratione data, prop. 46. And, concerning the Cycloide, in the 22 remaining Propositions; and at least 20 Confectaries. Because, though they had no other Faults, but that of a False Foundation, they must needs fall with it. But there being so many others, and some of them such Pretty ones, I cannot passe without letting You see a few of them.

In his prop. 46. To divide an Arch in any Proportion given; (beside that it is grounded on a false quadrature) supposeth also, That if a Circular Arch By (at least, if lesse than half

a Qua-

Quadrant) lye between two Parallel streight-lines, $\gamma\delta$ the Sine, and $\Gamma\beta$ a contingent line equal to that Arch; what ever streight-line Cuts those two Parallels Proportionally, doth also cut that Arch in the same Proportion. Which how Absurd it is, having shewed sufficiently in my *Elenchus*, pag. 97, 98, 99, 103,



104, 111, 112, 113. &c. (for he is oft harping upon the same string) I shall at this place say no more of it. And those Arguments or Evasions, with which *Thomas* is here satisfied, p. 148, 149. (because *Hobs* tells him, how truly, I will not say; That *prater numeros Ludolphinos* I have produced nothing to the contrary) are, there, shewed to be Absurd enough. Nor wil it be necessary to repeat them here, because the Absurdity is so very visible upon the first View, to any one who understands Mathematicks, though but a little.

His 47th Proposition, (which begins his discourse of the Cycloide, and on which the rest depend,) doth, in the Construction, presently suppose the truth of his *Ninth* Quadrature, That *Arcus Semicirculi potest Decem (Semicirculorum, lege) Semicirculorum*. And therefore, for want of a good foundation, that whole discourse falls. But there are, beside this, many other mistakes, of which I shall shew a few.

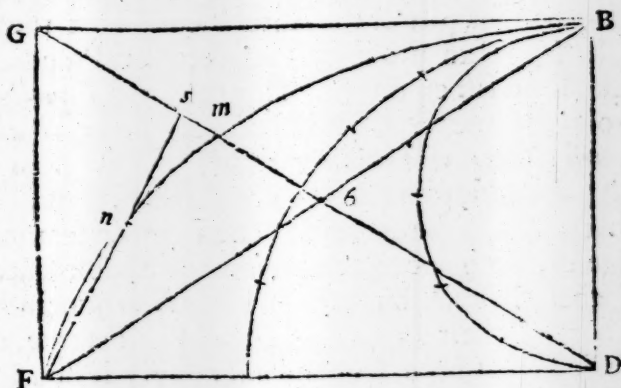
The first I shall mention, is a fine *Argute Sophism* (in the Demonstration of his 49th Proposition) called *Amphibologia*; (to shew, how Neatly he can play the Mountebank in Mathematicks;) and it consists, not in the Equivocal Signification of a single Word; but in the Ambiguous Syntax of the Sentence. 'Tis just in this form; *Octennium superat Decennium Biennio: Atque Octennium superat Sexennium Biennio: Aequantur igitur Sexennium & Decennium*. I know not well how to put it into English without playing the Poet; (for, in Prose, our English Syntax will hardly bear the Elegance of that Amphiboly.)

Eight-years Ten-years surpass by just Two-years ;

Eight-years surpass Six-years by just Two years :

That Six and Ten are equal, hence appears.

The first part of the Antecedent is true, if *Octennium* be, there, the *Accusative* case ; The second is true, if, in it, *Octennium* be the *Nominative* case : And the Consequence is true, if, in both places, it be either the *Nominative* or the *Accusative* ; (I mean, if in Both the *Nominative*, or in Both the *Accusative*.) And just such is his Argument,



(which I must give you in his own words, because a Translation would spoil it ;) *Superat Triangulum GFs spacium Cycloidale F6m, spacio trilineo snm, minus spacio bilineo FnF.* Which that it may be True, You are first to suppose *Triangulum* to be the *Accusative* Case, and *Spacium Cycloidale* the *Nominative*, and understand it thus,

$$FGm - GFs = snm - FnF.$$

But then again, to carry on his Argument, (the Consequence being otherwise lame,) You are, contrarywise, to suppose *Triangulum* to be the *Nominative* case, and *Spacium Cycloidale* the *Accusative* ; and understand it thus ;

$$GFs - FGM = snm - FnF.$$

To which he doth thus subsume, *Sed Triangulum sF6 (Triangulo GFs aequale) superat spacium F6m, eodem spacio trilineo*

trilineo snm , minus *spacio bilineo* FnF : That is

$$sF6 (=GFs) - F6m = snm - FnF.$$

From whence he concludes, *Therefore* FGm and $F6m$ are *Equal*. And on this Consequence, depends the most of that which follows.

In his next Proposition, *prop.* 50. he would prove, That the *two segments* FGm and BGm do *equiponderate* on the line BmD , Because they are *Equal*, and, *Equally Distant*. The Consequence is good, (if, by *their distance*, be meant, as ought to be, *the distance of their Centers of Gravity*;) but neither part of the Antecedent. That they are *Equal*, he supposeth proved in the precedent Proposition, whose proof we last examined. That they are *Equally distant* from the line GD , he thus proves, *Because B and F (the utmost Points of each) are equally distant from it*, (and, that their *Nearest parts* be *Contiguous*, is manifest.) But what is this to the purpose? The Equiponderation of two Figures, doth not depend upon the Equidistance either of their *Utmost* points, or of their *Nearest* points, or *Both*; but, of their *Centers of Gravity*. 'Tis true, that, had the Segments been *Like* and *alike-sited*; if *Equal*, the Equidistance of any two Homologous points would have concluded the Equidistance of their Centers of Gravity, and consequently their Equiponderation: But of such *Unlike* figures as these, the case is much otherwise. And this is such a Mistake as cannot easily be thought to proceed (as he useth to distinguish) from *Negligence*, or *Security*, but, from *Ignorance of the Subject whereof he treats*. He might as well have concluded, that a *Semicircle* and a *Trapezium* equal thereunto, whose *Pases* are the same, and their *Heights* equal, would Equiponderate on opposite sides of their *Common Base*; For he might here prove, as much as in the present case, That their *Utmost points* are *Equally-distant* from that common Line; and their *Bases* *Contiguous*. But no man, who knows what belongs to *Statics*, would hence infer, their Equiponderation: Because the

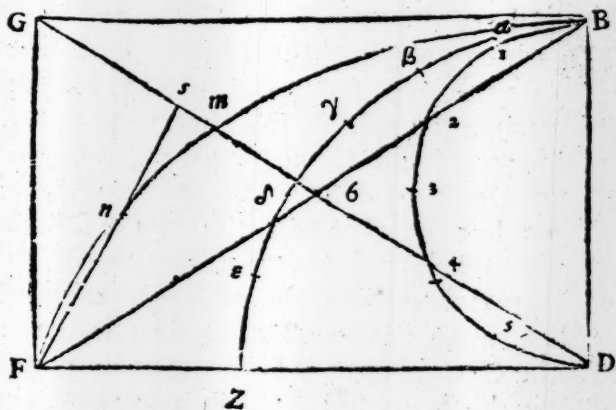
Equidistance

Equidistance of their Centers of Gravity cannot be hence concluded. And 'tis certain, that the *Trapezium* must needs Preponderate.

The same Errour, he doth presently commit over again, to prove, That $F6m$, and $B6m$, do also Equiponderate upon the same line. And then, a third time, to prove the like of FDm , and BDm .

And these *Fundamental mistakes* (with some others as good) do so infect all that follows, That, beside the first false Construction of *prop. 47*, which infects the whole; There is not in all that follow, unlesse *prop. 48, 54, 55, 58*, (which yet are not exempt from the influence of that false Construction) and *prop. 67*, with one of its Consecutaries; any One Proposition, which is not also, *Otherwise False*.

I shall yet instance but in one more. (For I do not judge it meet to give You the trouble of a particular account of all.) 'Tis *prop. 62*. which I rather single out, as well, because it is not so complicated with the rest, but that it may be considered apart; as also, because the Demonstration of it, is somewhat extraordinary.



He doth first, Supposing the Arch of the Semicircle B_3D to be divided into any number of equal parts, at the points

points 1, 2, 3, &c. and that of the Quadrant BZD; into the same number of equal parts, at the points α, β, γ , &c. Indeavours to prove, That, Because B α , B β , B γ , &c. in the Quadrant; are equal to B1, B2, B3, &c. in the Semicircle; and the *Right-Sines* of Those, to the *Chords* of These; (which is True:) Therefore, if, from the points α, β, γ , &c. in the Quadrant, be let fall Perpendiculars, or Right Sines, on their Semidiameter BD; these *Right-Sines* of the Quadrant, will cut the Semicircle, each in its respective point, 1, 2, 3, &c. Or, (which is equivalent,) if that Quadrant lye not in the plain of this Semicircle, but stand erect perpendicularly upon it; those Right Sines from α, β, γ , &c. will fall on the Parallels to DF, which passe through the Points 1, 2, 3, &c. respectively. Which is so wild a Consequence, (and the thing inferred so absurd,) that I know not how to fit it with an Epithere so Mild, as may not make You apt to say, *I am Severe*. The worst I shall say of it is, That, it is one of *Mr Hobbs's Consequences*.

And that which next follows, is just like it. Having thus-proved, That if that Quadrant be erected perpendicular to the plain of this Semicircle, on any of the Parallels to BD, which compleat the Right-angle DG; the Sines let fall from α, β, γ , &c. will fall on the Parallels to DF passing through the respective Points, 1, 2, 3, &c. He thence would prove (by a Consequence as good, as either Antecedent or Consequent is true,) That the Parallels to BD which compleat the plain of the Cycloide DBmF, do continually decrease in *Arithmetical Proportion* till that at F they vanish; as also the Quadrantal Archs described by those Parallels upon the Axe DF: (That is, he would prove, that the Cycloid BmF is a streight line: For, That the Parallels in the Triangle DBmF do so decrease, is manifest; and the Quadrantal Archs by them described:) And, therefore, that the Plains of those Quadrants do decrease in the Duplicate proportion of lines so decreasing: (That

is, That the Solide described by the conversion of the Cycloide DBmF upon the Axe DF, is a Cone : For, that the Plains of the Cone, made by such conversion of the Triangle DBmF, do so decrease, is manifest.) Which is a Mistake so Like the former, as if they were *Twins*.

There is yet a Third so like these two, that, though I must not say, they be *Three Twins* (lest it should seem a Solæcism,) yet they look so much alike as if they were all Born at *one* birth. For having proved, (as he supposeth,) that the Parallel Plains, which cut at equal distances the Solide described by conversion of the Cycloide DBmF upon the Axe FD, to Decrease in the Duplicate proportion of Lines continually decreasing in Arithmetical Proportion: He thence infers, (what that *prop. 62.* affirms,) That the Solide made by this Conversion, is to the Cylinder made by a like conversion of the Rectangle CD, as 2 to 3. Which is neither *True* (for 'tis indeed as 5 to 8,) nor doth it follow from what he pretendeth to have proved. For, did those parallel Plaines decrease in such proportion, (that is, were that Solide, a Cone ; as, by such supposition, it must needs be ;) the proportion would not be, as 2 to 3, (as he infers,) but, as 1 to 3 : For, such is that of a Cone to the Circumscribed Cylinder.

I promised You to give but this One Instance : And therefore shall with this conclude what I say to the Geometry of his Discourse concerning the Cycloide. Onely, as an *Instance* of his good Language, (for I do not purpose to afflict Your Ears with much of it,) I shall repeat a line or two. Having *prop. 67.* (which is the onely True Proposition of all that concern the Cycloide,) affirmed, That Cylinders are in Proportion compounded of that of their Bases and that of their Altitudes ; He tells *Thomas* (who seems to doubt it) that *Hobs*, hath Demonstrated the truth of this Proposition ; (and glories in it, as if it were a discovery of his own, never known before :) *Demonstrat. in Hobbins lib. de Corpore, cap. 13. Art. 14. Quod Caput ipse Wallisius*

Wallisus non improbavit; sed quia nihil in eo reperit quod potuit rodere, Hobbii ipsius esse negavit. Non quod alienum esse putarat, sed quia instituto ejus Mentiri expedivit. Nor shall I make any other Reply to it, but onely refer You to what I have said against that Chapter for ten pages together in my *Elenchus* (from pag. 16. to pag. 25. inclusive.) From whence, I suppose, You will be satisfied, That neither I had said nothing against it, nor do I deny it to be his. Much of that Chapter is, doubtlesse, his own; though the *Best* of it, I suppose, he will not deny to have been known before. And then, To whether of us Two, the *Expedient* he mentions doth belong; I shall leave to You to judge.

To his Appendix: Wherein he pretends to *Amend* somewhat that was Amisse, in his book *De Corpore*; I shall say nothing. For, though indeed it be somewhat *Altered*, I do not find that it is *Amended*. The fundamental Mistakes still remain; and so it stands Confuted as before.

I shall, here, conclude this long Digression. Wherein I have given You some Account of his *Six Dialogues* written against me: Not onely to shew You the Reasons for which I did not then think it necessary for me to Answer them: But rather to make it evident to You, That the *Author of those Six*, may, without danger, be *Neglected*, when he writes a *Seventh*; (which is the first part of what I was to shew;) And (which is the latter part) That he, who takes all those to be good *Geometry*; and, hopes from thence to raise a *Reputation* of being the *First that hath made the Grounds of Geometry, Firm and Coherent*, will Need at last, if not *Deserve*, Your *Pitty*.

His *Seventh Dialogue*, Intituled, *Dialogus Physicus*, (which gave occasion to this Discourse,) remains yet to be considered. Which though it seem mainly to be directed against those Noble *Experiments* of Your *Pneumatick Engine*; Yet (so much is he concerned, in every thing he doth, to be revenged of me, for not approving his *Mathematicks*),

maticks,) he cannot conclude it, till he have first distributed some tokens of his displeasure towards me, for presuming to answer a Paper (which proved to be *His*, but was pretended to come from *France*,) pretending to the *Geometrical Duplication of a Cube*. Which, though it there come in the last place, You will give me leave to take first into Consideration, because of its Connexion with that whereof we last discoursed.

Having therefore taken occasion pag. 32. (from what he had before been treating of concerning Your *Pneumatick Experiments*,) to commend his *Physicam Hobbianam*, (which might be allowed as consonant to the present Subject, being an Inquisition into the *Nature of the Air*,) He proceeds to commend his *Ethicks*, and *Politicks*, (Not because the subject whereon he was discoursing lead him to it; but, because he thinks it necessary, when ever he writes any thing, to Commend All that ever he had written before;) But, more especially, his *Geometry*; his (manifold) *Quadrature of the Circle*, his *Division of an Arch, or Angle*, and what he had lately delivered concerning the *Cycloide*, and the *Center of Gravity in a Semicircle*, contrary to what others had before demonstrated; (which being the last things he had written, and not yet commended by any, 'twas necessary that *Thomas* and *Hobs* should mutually declare their approbation of them:) Which leads him to that of his *Duplication of the Cube*, (as, much conducing to the Explication of the *Nature of the Air*:) whereof, had he not thus publickly owned it, he might have lost the credit.

For, Observing that *Mr Hobs's Geometry* (whether by reason of others Envy, or for what other cause, I will not now dispute,) was not now in any great Repure; and, Fearing least that *Odium Hobbii*, which he so much complains of, as so prejudicial to Man-kind in hindring the reception of his Notions, without which it is impossible to make any progresse in the Search of Nature; (For,

Convenient,

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Convenient, *Studia conferant, Experimenta faciant quantum volunt, Nisi & principiis utantur meis, Nihil proficient*; The Nature of Motion, the noblest and most necessary piece of Mathematicks, he tells us, being never yet Touched upon by any but Mr Hobs;) might be prejudicial also to this of the Cube, (and, thereby, not onely deprive him of the Credit, but all man-kind of the Benefit, of his New Discovery:) To obviate those evils; he caused his *Probleme of Doubling the Cube*, to be printed in French; (as done by V. A. Q. R. which he now interprets to signifie *Un Autre Que Roberval*;) and divers papers of it to be given abroad, which were pretended to be brought from Paris; (For had it been in English, or thought to be done at home, the Matter would presently have betrayed the Author:) Not doubting, but that, the *Odiu*m would cease to operate when the Person was concealed; and, no Prejudice obstructing an impartial Estimate, his Demonstration would presently find Reception and Approbation: Which could not afterwards be withdrawn, when He should appear to be the Author. By which means, he should both Benefit Mankind against their wills, and, unawares, receive their Approbation.

But, so ill a Fate attends his Actions though in Disguise, and that secret Antipathy to Mr Hobs's Inventions, though not known to be his, did operate so strongly; that, notwithstanding the Artifice, this Demonstration fared no better than those he did avow for his. And, which is worst of all, when it had received Confutation from several hands (which might have taught any man who could but *Understand*, though he knew not how to *Make* a Demonstration, What was to be done;) He, Then, proclaims himself the Author of it; when it had been more prudence, by concealing himself, to decline the Reproach of what he thinks a Credit.

The Paper, made English, speaks thus.

"The Doubling of the Cube.

"By V. A. Q. R.

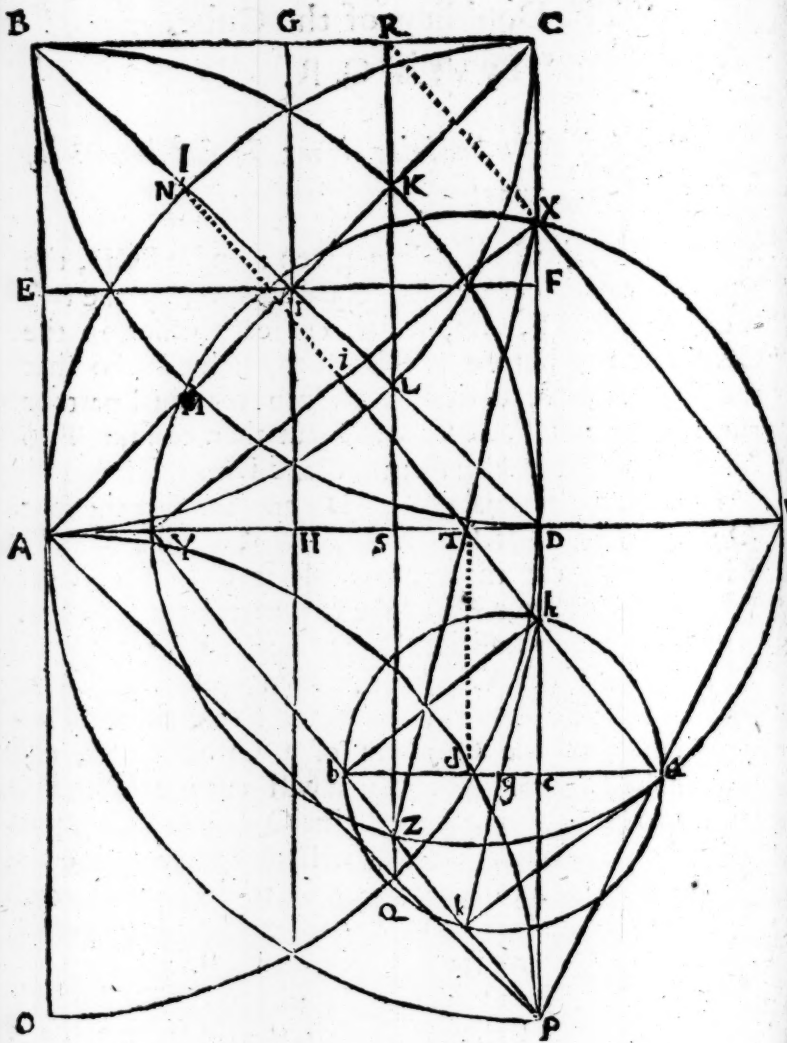
*"A Streight-line being given; To find between It,
and its Half, Two Means Proportional.*

"Let AB be the streight-line given; and ABCD, the Square thereof, cut into four equal Squares, by the two streight-lines EF, GH, which cut each other in the Center of the Square ABCD, at the Point I: So that the four sides be divided each into two equal parts at the four points E, F, G, H. I am then to find Two Means Proportional between DC and DF.

"I draw the Diagonals AC, BD; and describe the four Quadrants of Circles ABD, BCA, CDB, DAC; whose Archs cut those Diagonals in K, L, M, N. At which Points, those Archs are cut, each into two Equal parts. Which is sufficiently known so to be.

"I produce BA, CD, to the Points O and P, so far as till they be equal to AB, DC, each to each. And having described the Quadrant of a Circle ADO, and drawn the Diagonal AP, (which will cut the Arch DO into two Equal parts, at the point Q.) And being produced on the other side at R, will mark BR equal to the Right-Sine of 45 degrees, that is, to the Semidiagonal BI. And by consequent SD is the Excesse of the greater Extreme AD above the Semidiagonal AS.

"This SD, I cut in two Equal parts at T. And, in AD produced, I take DV equal to DF, and making T the Center and TV the Semidiameter, I describe the Circle VXYZ, cutting DC in X, DA in Y, and the streight-line RS produced in Z. And I say, that the



“ two streight-lines DY, DX , are the two Means Proportional required, between DP equal to AB , and DV equal to its half.

“ For, drawing the streight-lines VX, XY , the Angle VXY (in the Semicircle) will be a Right Angle; And the streight-line XT drawn and produced unto the Concavity of the Circle $VXYZ$, will fall on Z , because ST , and TD , are equal, and by consequent SZ equal to DX , and XZ will be the Diameter of the Circle $VXYZ$. The Angle therefore XYZ in the Semicircle is a Right-Angle; And, drawing the right line VZ , it makes $VXYZ$ a Rectangle, and its sides VX, YZ , parallel.

“ Now, if the streight-line YZ produced, fall upon P , the whole PZY will be a streight-line parallel to VX ; and the alternate Angles YPX, VXP , equal. And the Angles YPX , and XYD , will be also equal; and the three Right-angled Triangles PDY, YDX, XDV , will be like Triangles. And consequently, the four streight-lines PD, DY, DX, DV , will be in the same continual proportion.

“ I am therefore to Demonstrate, that YZ produced, will fall upon P .

“ Let PV be drawn, and cut into two equal parts at a . And also the streight-line ab drawn parallel to AV , cutting PD in c . And likewise Td drawn parallel to PD , cutting ab in d ; and dc divided into two equal parts at g . On the centre g , at the distance ga , let the Semicircle abb be described, cutting PD in b , and ab in b .

“ This being done; the two streight-lines ah, bh , being drawn will make a right Angle at b . Now ac is the half of DV . And, because dg and gc are equal, ab will also be equal to the half of DV , and ab will be the half of YV .

“ Therefore, as PD to DY , that is to say, to the compound of DS and SY , so is Pc (the half of PD) to cb

“the compound of the halves of DS and DY, and consequently *Pb* produced will fall upon Y. And the straight lines *hb, ha*, will be the halves of XY, XV. And XY being divided into two equal parts at *i*, the figure *Yihb* will be a Rectangle, and Yb parallel to XV. But YZ is parallel to XV. Therefore YZ produced will fall upon P. And (by what hath been demonstrated) the four straight-lines PD, DY, DX, DV, will be in the same continual proportion. I have therefore, between a straight-line given and its half, found two Means Proportional. Which was to be done.

“Confectary. A Cube whose Side is the Greater (*legs, the L sser*) of the two Means, is the double of that Cube whose Side is Half the Greater Extreme. For the Proportion of the Cube to the Cube, is Triplicate to that of the Side to the Side; And the Proportion of PD to DV is Triplicate to that of PD to DY.

I thought fit to recite his Paper *verbatim*, not onely to let You see, How like an Artift Mr *Hobs* hath done it; but likewise because in his Reply to my Confutation, he puts me to prove a Negative (That such a thing is *not demonstrated* in his paper.) And though I had already proved it to be False (and consequently, that it was not Possible to be demonstrated;) yet, because this proof doth not seem to him sufficient, I have produced the whole, that You may see if any where therein You can find this Impossibility performed.

You may perhaps wonder (and so did I till I knew Mr *Hobs* was the Author of that Paper) why he should clog his Figure, and the Construction of it, with such a Multitude of superfluous Lines and Letters, whereof he makes no use at all either in the Construction of the Probleme, or the Demonstration of that Construction.

For, first, he doth h, on the Line given, describe a Square; This Square he doth then doubly divide into four Quar-

ters; once, by two Crosse lines parallel to the sides; and again, by two Crosse Diagonals from Corner to Corner. He doth then inscribe four Quadrants of Circles; whose Centers are the four Corners of that Square; and their Archs passe each by two other of the Corners. The two former streight-lines, parallel to the Sides, divide the whole, he tells us, into four Equal Squares: That they Cut each other at a certain Point, which point of Intersection is the Center of the whole Square; and, That the four Sides of that Square are each of them cut into two equal parts by those crosse-lines: (equal to one of which he doth afterwards take the Line DV in the continuation of AD.) And the two crosse Diagonals, he tells us, are cut in four Points, by the four Quadrantal Archs; At which Points they do also cut those Archs into equal parts.

Now, whereas You might expect to hear, what use is to be made of all this Construction hitherto; The utmost that is to be said of it is but this; *Let AD, equal to the Line given, be continued to V, so that DV be equal to the half thereof; and let DX be perpendicular thereunto.* Which might as well have been said at first. And therefore that Square described, with all its Implements, are to no purpose.

He then proceeds to describe Three Quadrants more, in another Square on the other side of the Line DA. Bisectiong one of them by a Diagonal at Q; whence QSR (parallel, I suppose, though it be not said so, to AB) is continued to the further side of the other Square, at R. Two of which Quadrants thus described are never after so much as mentioned, nor is any use made of them at all. The third Quadrant, with the Diagonal, and QS (part of the line QSR) though they might have been spared, yet I do not find fault with, because there is some use made of them in designing the point S.

The use that is made of this part of the Construction is this, (which might have been said without it :) *Now suppose AD the Radius of a Circle, let AS, part thereof, be equal to the Sine of 45 Degrees.*

He

He then proceeds to this purpose. *Bisecting then SD at T; on the Center T, by the point V, draw a Circle, cutting DX at X, and AD at Y. The lines DY and DX are the two Mean-Propotionals, between AD, and, its half, DV. Which ends the Construction of the Probleme. The whole whereof, which he (confusedly) delivers in Four Paragraphs; is, You see, more clearly and more to the purpose expressed in little more than so many Lines.*

When His Paper, so drawn, was brought me, (not knowing who was the Author, but supposing it to be sent from *France* as was pretended,) I was surpris'd; and, wondred much that any other man should write so like Mr. *Hobs*; (having formerly thought, that this way of Geometriziing had been peculiar to himself, and unimitable by any other.) And supposing, by the manner of it, that it was done by some Youngster, who had lately applyed himself to Mathematicks, but was unacquainted with the Methods of Construction and Demonstration; I did first, without any reflexion, (more than a bare intimation, that there was much superfluous, and some mistakes,) reduce his Construction and Demonstration for him, into somewhat a better form, (that he might see, how much it was out of order, as he had done it; and the better discern where its strength lay, and, where its weaknesse.) And suited a Figure to the Construction thus Amended, (to let him see, how much of his was wholly Superfluous:) leaving out most of the Superfluities in his; but retaining all that was any way usefull. And then adjoynd a threefold Confutation of it.

The former part of this, it seems, Mr. *Hobs* did understand: And therefore thought fit to suppress his own, and publish his Probleme and Demonstration in that Form, that I had drawn up for him; (but retaining his own Figure, with all its superfluities.) But the latter part, which contains the Confutation, it seems, he understood not. For, had he understood it, he would not have been so imprudent

as to expose himself as the Authour of that weak mistake, when he had the opportunity of concealing it.

And he hath in both, Truly enough represented my words, or the sense of them, (so much, I mean, thereof as he thought fit to expresse;) save onely that, instead of 1,997. or (as I had written it) 1997, he hath twice substituted 1997, (leaving out the note of Separation between the Unite, and the Decimal parts annexed;) and then makes advantage of this Falsification.

His Demonstration, omitting the superfluities, is to this purpose. *Drawing the Diameter XTZ, and the streight-lines VX, XY, YZ; the Angles VXT, XYZ, are Right Angles; and YZ parallel to XV. And therefore, if YZ continued, till it meet with XD produced, do cut off DP equal to DA or the double of DV, (the Triangles PDY, YDX, XDV, being like Triangles,) the lines DP, DY, DX, DV, will be in continual proportion: And, the Cube of DP, double to that of DY. And thus far his demonstration is right.*

Now, *That YZ so produced will cut off DP equal to DA,* he thus endeavours to prove. *Take DP equal to DA, (I add, or of what length soever; For, whatever the length of it be, the Demonstration proceeds as well;) Drawing the streight-line PV, and bisecting it at a; and drawing ab parallel to DY, cutting DP at c; and Td perpendicular to ab: then, bisecting dc at g; and, on the center g drawing, by the point a, a Semicircle, cutting cD at h, and ab at b: Because ca is equal to the half of DV; and cg to the half of DT; ab will be equal to the half of VT; and therefore, joyning Pb, this continued, will fall upon Y; and joyning bh, ha, these will be equal to the halves of YX, XV, and parallel therennto. Which is likewise true: But so is not that which he infers from it, viz.*

Bisecting therefore YX in i, and joyning ih; the figure Tihb will be a Right-angled Parallelogram: and therefore YbP will be Parallel to XV, and consequently, the same with YZ produced.

But here his Demonstration is lame, and, consequently,

his

his whole Proceſſe failes. And I had given him a threefold Confutation of it.

Fiſt I ſhewed, Where his Demonſtration was defective. He had proved indeed, *That bh is equal and parallel to Ti*; and, conſequently, *That bY* was alſo Equal and Parallel to *hi*; and therefore, that *Tibb* is a *Parallelogram*; but not, *That it is Right-angled*: there being nothing in all the Proceſſe to determine, what are the Angles of that Parallelogram; the Equality of the Parallel ſides being the onely thing proved; which is as true in *Rhomboids* as in *Reſtangles*. That which I took to be the occaſion of his miſtake, I ſayd, was this; That, having proved *abb* to be a Right Angle, and *ab* parallel to *VX*; and, imagining (what ſhould have been proved) that *hi* was the Continuation of *ab*; he did, conſequently, imagine, that *bhi* was alſo a Right Angle, and *bi* parallel to *VX*. But, That *hi* is the Continuation of *ab*, ſhould have been proved, (not, taken for granted,) the whole weight of the Demonſtration lying upon it. (Nor is it indeed True; For *ab* continued, will never come at *i*; but paſſe ſomewhat lower, between it and *Y*: *XYb*, and *ibb*, being here Obtufe Angles.)

What he Now offers for the proof of it, is but a Repetition of the ſame Miſtake. *Who ſees not*, ſayth he, *That if, compleating the Circle, we draw the Diameter h g k; the line h k will be Equal and Parallel to T Z; and Pb to a T;* (which is very true;) and, conſequently, (but this Conſequence I cannot ſee) *that ah paſſeth through the Center T, and biſects XT at Right Angles at i*? He doth again imagine (but hath not proved) that *ab*, *bT*, and *Ti*; are all parts of the ſame ſtreight-line *ai*. Whereas, in truth, they be Three different Lines, and make Two Angles, one at *h*, another at *T*; nor is any of them a part either of *ai*, or of *bi*, or of *aT*. 'Tis true, that *Ti* biſects *XT* in *i* at Right Angles; and, that *ab* continued will ſomewhere cut *XY* at Right Angles, not in *i*, but ſomewhat nearer to *Y*; and, *ab* is indeed Parallel to *Ti*, but not a part of the ſame ſtreight-line

with it ; Nor will a freight-line from a to i , come at all either at b or T , but somewhat higher than b , and lower than T , cutting bT in the middle ; Nor is hi part of the freight-line ai , but makes an Angle with it at i . 'Tis true also that Pb is Parallel to a freight-line from a to T , but not to the line ab ; nor will that freight-line from a to T , come at b at all ; nor is coincident with hi continued, but Parallel thereunto. (So many Mistakes are there in one Amendment !) And, whereas Mr. *Hobs* imagineth (without proof) that ab, bT, Ti, aT, hi , and ai , ly all in one continued freight-line ; they are indeed Six severall freight-lines ; whereof ab, Ti , and aT, hi are the opposite sides of a Rhomboid ; and ai, bT , the Diagonals of it, (And, if he think otherwise, he should have proved it, not, taken it for granted.) 'Tis true indeed, that there is a Point somewhere, to be taken ; where, if we place P , the foure points a, b, T, i , will ly in one freight-line. But that this point is at a Distance from D , juſt Double to DV , he hath not proved.

And the better to expreſſe all this, I thought fit to adde a Figure, of my own, ſuited to the Conſtruction and Demonſtration as it is here amended. Wherein I have retained, of his, ſo much as was neceſſary to expreſſe the True Proceſſe of his Conſtruction, and the Full Strength of his Demonſtration : Omitting thoſe Superfluous Lines and Letters (which, You ſee, were very many) which ſerved but firſt to confound Himſelf, and then his Reader. And I have therein purpoſely taken the line DP , not precisely equal to DA , but, at pleaſure, (as is intimated in my Fmendment :) As well the better to expreſſe thoſe Six Lines belonging to the Rhomboid $ahiT$, (which, though diſtinct, would yet have lyen ſo near to one another as not to be expreſſed conveniently to the view ;) As alſo, that the ſame Figure might ſerve for my Second Refutation, which now follows.

My Second Refutation was, Becauſe the length of the line

line DP, which is the chief thing to be Demonstrated, is not at all concerned in his Demonstration. But, what ever be the length of DP, (whether equal, greater, or lesse than the double of DV,) his Demonstration proceeds alike. And therefore, doth no more prove, that DX, and DY, are the mean-proportionals between DV, and DP the double of it; than, between DV, and DP of what length soever.

But for this, he sayth, *I bring no Demonstration*. It's very true; (nor was it my business, there, to bring a Demonstration; but, to Answer what he pretends to be a Demonstration, and shew the weaknesse of it:) But had he reviewed his Demonstration, and applyed it to DP of any other length he pleased; he would have found (without a Demonstration of mine,) that it would proceed *verbatim* just as it doth now. For, *what ever be the length of DP*; if he joyn PV, and from its middle point *a*, draw *ab* parallel to VY, cutting PD at *c*, and, from T, let fall the Perpendicular *Td*; and, (bisecting *dc* in *g*,) on the center *g*, draw the Semicircle *abb*; (and so forth, as in his construction;) Because *a* is the middle of PV, *c* will be the middle of PD, and *ac* equal to the half of DV, and *cg* to the half of DT, and therefore *ab* to the half of VY; and, consequently, *Pb* continued, will fall upon Y; and *bh*, *ha*, will be equal to the halves of YX, XV, and parallel thereunto; and *hi* parallel *bY*, and equal to it: (which is all that he proves in his case.) If therefore from hence he can infer, *in his case*, that *Tibb* is a *Rectangle* (and, consequently, *YbP*, the same with *YZ* produced;) I may as well infer it, *in any case*; and conclude, as he doth, that DX, and DY, are two mean-Proportionals between DV, and DP, whatever be the length of DP. His Argument therefore, either doth not prove, That they are the Mean-Proportionals between DV, and the double of DV; or else it doth also prove, That they are the mean-proportionals between DV and any line whatever. *Quod erat propositum*. So that, You see, it

was not for want of a Demonstration, that he had it not at first; but onely upon a Presumption, that the Authour of the Paper had known how to apply his own Demonstration to another case, without my help.

My Third Refutation, undertakes to shew, not onely that what he affirms is Undemonstrated, but that 'tis False: And doth demonstrate, that DX, DY , are not (as he affirms) the two Mean-Proportionals between DV and the Double of DV ; but, between DV and a line somewhat Lesse than the Double of it. Thus. Supposing DV , equal to 1. DA the Double of it will be equal to 2. And AS (which is to DA , as the Sine of 45 degrees to the Radius, or as the Subtense of 90 degrees to the Diameter) will be $\sqrt{2}$. And, therefore, SD equal to $2 - \sqrt{2}$. Which added to SY (equal to DV) makes YD equal to $3 - \sqrt{2}$. And, consequently, DX , (a mean-proportional between DV and DY , that is, between 1 and $3 - \sqrt{2}$), is equal to $\sqrt{1 \cdot 3 - \sqrt{2}}$: (the Foot-Universal of $3 - \sqrt{2}$.) And therefore, the Fourth Proportional must be (not 2, as Mr *Hobs* affirms, but) $3 - \sqrt{2}$ into $\sqrt{1 \cdot 3 - \sqrt{2}}$ For,

As DV , to DX :: So is DY . to the Fourth.

$$1. \sqrt{1 \cdot 3 - \sqrt{2}} :: 3 - \sqrt{2}. \quad 3 - \sqrt{2} \text{ into } \sqrt{1 \cdot 3 - \sqrt{2}}.$$

Which Fourth (reduced to ordinary numbers) is equal to 1,997 fere; and is therefore lesse than 2, the double of DV . *Quod erat ostendendum.*

I do not know, whether it will be worth Your while, to consider of Mr *Hobs's* Answers to this Demonstration: But, because it may be conducing to what I am moving for, I shall present them as they are.

First, That this Fourth Proportional is equal to $3 - \sqrt{2}$ multiplied into $\sqrt{1 \cdot 3 - \sqrt{2}}$; he doth very well perceive; but, That this is equal to 1997, he saith, he cannot understand. Truly, no more can I. But, if he cannot understand how it can be equal to 1,997 fere, or (as I had then written it) to 1 997 fere; he can understand very little. For if he

have

have so much Arithmetick as to extract the Square root of a number given; he might understand that

$\sqrt{2}$ is equal to 1.41421,3564

and therefore $3 - \sqrt{2}$ equal to 1.58578,644--

and its root, $\sqrt{3 - \sqrt{2}}$ equal to 1.25928,013--

and $3 - \sqrt{2}$ into $\sqrt{3 - \sqrt{2}}$ equal to 1.99694,935--

That Fourth Proportional therefore is somewhat lesse than 1,997, or $1.\frac{997}{1000}$, and therefore not equal to 2. Which, if Mr Hobs cannot understand, it is not my fault.

Next, because he doth not understand this; He endeavours to find the length of that Fourth Proportional, his own way. And first he thinks it fit to change the Measure: And whereas I supposed DV to be 1, and therefore DA (the double of it) to be 2; He will suppose DA to be 1000, and DV to be 500: (Which I do not blame; because it is as free for him as for me, to take the first term at pleasure:) And, consequently, AS to be $\frac{1}{2}\sqrt{2000000}$, which is somewhat more than 707. And therefore DY somewhat more than 792, but lesse than 793. Wherefore, saith he, $792 \approx 3 - \sqrt{2}$. That is, (for so, I hope, he would be understood) 792 of his measures, equal to $3 - \sqrt{2}$ of mine. The root of which 792 is equal, he saith, to 28 fere; (that is, to somewhat more than 28, though lesse than 29.) The product therefore of 28 multiplied into 792 is, saith he, the Fourth Proportional. That is, according to his Arithmetick,

DV. DX. DY. A fourth. } are in continual Pro-
500. $\sqrt{792}$. 792. $792\sqrt{792}$. } portion.

I need not tell You, That there is an Errour in his Calculation. ('Tis visible, and too grosse.) I shall onely tell You, what I take to be the Occasion. Having taken 792 in his measure, as equal to $3 - \sqrt{2}$ in mine, for his Third term; And, observing that, in my Analogy, (because the first term is 1,) the Square-Root of my Third term, is equal

to my Second: He thinks that, in his Analogy, (where the first term is 500,) it must be so to. And hence concludes, That the Third Term multiplied into its Root, in his Analogy, (because it did so, in mine,) will give the Fourth Proportional. Whereas a little Arithmetick might have taught him, That, although $\sqrt{3-\sqrt{2}}$ be the mean-proportional between 1 and $3-\sqrt{2}$; yet is not $\sqrt{792}$ the mean-proportional between 500 and 792, but between 1 & 792.

I forbear to advertise further, That his Calculation, whether Right or Wrong, doth, no more than mine, answer his Geometrical Construction, (for his $792\sqrt{792}$, or 22176, is no more equal to the Double of 500, than my 1,997 *fers* to the double of 1; but, as he computes it, *more than Twelve times as great*; I should have said, *More than Two and twenty times*:) Because it was not his design by an Arithmetical Calculation to prove the truth of his Geometrical Construction; but, to shew that *several Computations Arithmetical do not agree amongst themselves*. And this, if he mean it of a Right and a Wrong, I shall easily grant him: And the Instance he hath brought, doth prove it.

His Third Attempt upon my Demonstration, is, To tell Thomas, what he thinks to have been the Occasion of Mistake in my Calculation. (For, that there is a Mistake, either in His, or Mine, is very certain.) *The Error*, he saith, *is no other but this, That I take, DX to be equal to $\sqrt{3-\sqrt{2}}$* . And is true, that I do so take it. But why is it an error, so to do? *He thinks, That I did thus argue; Because 1 multiplied into $3-\sqrt{2}$ makes $3-\sqrt{2}$, therefore $\sqrt{3-\sqrt{2}}$ is the mean proportional between 1 and $3-\sqrt{2}$* . Why he should think that I do thus argue, there appears no other Reason, but, Because he thinks it is an Error, and it is fit that I should be thought to Erre. For there is not in my paper any mention of such Multiplication, or, of what would be the Product of it. But, suppose I had thus argued, Why should he think it an Error so to argue? *'Tis true*, he saith,

saith, That if $3--\sqrt{2}$ be multiplied barely into 1, it makes $3--\sqrt{2}$ without alteration: (Yes, it doth so;) But, if multiplied into One-line, it makes a Rectangle. I might here ask, Whether when he saith $3--\sqrt{2}$ multiplicatus in Unam Lineam, facit Rectangulum, He mean, the Line $3--\sqrt{2}$, or the Number $3--\sqrt{2}$. If, the Line, he should have said Multiplicata, or rather ducta (for Linea is of the Feminine Gender:) But if, the Number; then the Latine is True, but the Geometry is False: For a Number multiplying a Line, doth not produce a Rectangle, but a Line; Two Yards being as much a Line, as One Yard; not a Rectangle. But I am content to believe, that he intended it of the Line $3--\sqrt{2}$. And then, tis very true, That the Line $3--\sqrt{2}$ into the Line 1, makes $3--\sqrt{2}$ a Rectangle, not, a Line: (Nor is there any other reason why he should think I was Ignorant of it, but onely, Because He Knew it; As if he thought, It ought to be presumed, That I am Ignorant of whatever He Knows.) But, I suppose, he knows also, That this Rectangle is equal to some Square; and, That the Side of this Square is a Line; And, That this Line is equal to $\sqrt{3--\sqrt{2}}$: And therefore the Line $\sqrt{3--\sqrt{2}}$: is the mean-proportional between the Lines 1, and $3--\sqrt{2}$, as I affirmed. And then, Where lies the Mistake?

So that I should not argue (as Mr Hobs imagineth) The Line 1, multiplied by the Line $3--\sqrt{2}$, makes the Line $3--\sqrt{2}$, and therefore $\sqrt{3--\sqrt{2}}$: the Root of this Line, is the Mean-proportional; But rather thus, The Line 1, into the Line $3--\sqrt{2}$, makes (not a Line, but) the Rectangle $3--\sqrt{2}$; To which Rectangle if we suppose a Square Equal, The Side of this Square will be a Line (not a Rectangle) and this Line will be equal to $\sqrt{3--\sqrt{2}}$. And therefore the Line $\sqrt{3--\sqrt{2}}$: is equal to DX the mean-proportional between the Line 1, and the Line $3--\sqrt{2}$. that is, between the Lines DV, and DY.

As for example; Suppose we this 1, to be 1F, (or if the Symbol displease him, in stead of 1F, he may say One Foot, and then 'twill cease to be a Symbol;) If therefore

DV

DV be equal to $1F$, or F into 1 ; DY will be equal to F into $3 - \sqrt{2}$, (for that DV to DY is, as 1 to $3 - \sqrt{2}$, he doth not deny:) And consequently, the Lines, $DV = F$ into 1 , and $DY = F$ into $3 - \sqrt{2}$, will contain a Rectangle $DV \times DY$ equal to FF into $3 - \sqrt{2}$. Which Rectangle is therefore equal to the Square of the Mean-Proportional DX , and the side of that Square will be, F into $\sqrt{3 - \sqrt{2}} = DX$. And, consequently, as the First Terme $1F$, multiplied by $\sqrt{3 - \sqrt{2}}$, gives F into $\sqrt{3 - \sqrt{2}}$ equal to the Second DX , so $DY = F$ into $3 - \sqrt{2}$ the Third terme, multiplied by the same $\sqrt{3 - \sqrt{2}}$, makes the Fourth term F into $3 - \sqrt{2}$, into $\sqrt{3 - \sqrt{2}} = 2$. That is, The length of the First term DV , whatever it be; multiplied (not by 2 , as Mr. Hobs would have it, but) by $3 - \sqrt{2}$ into $\sqrt{3 - \sqrt{2}}$ is the Fourth Proportional. Nor was it any Error in me, so to affirm. The whole Proceſſe of the Calculation is this.

$$1F, \text{ or } F \text{ into } 1 = DV.$$

$$F \text{ into } 3 - \sqrt{2} = DY.$$

$$\text{therefore, } FF \text{ into } 3 - \sqrt{2} = DV \times DY = DX^2.$$

$$\text{and, } F \text{ into } \sqrt{3 - \sqrt{2}} = DX.$$

$$\text{Then, As } DV = F, \text{ is to } DX = F \text{ into } \sqrt{3 - \sqrt{2}}.$$

$$\text{So } DY = F \text{ into } 3 - \sqrt{2}. \text{ To } DP = F \text{ into } 3 - \sqrt{2} \text{ into } \sqrt{3 - \sqrt{2}}.$$

$$\text{Not, to } DP = F \text{ into } 2; \text{ as Mr. Hobs affirms.}$$

I have now done with His Reply to my Refutation of his pretended *Doubling of the Cube*. There was, he tells us, beside this, Another *Refutation* of it; which, he sayth, is *very Probable*. And I could tell him of a Third; from a *Noble Hand*. But this Third was in *Symbols*, and therefore he did not think fit to understand it, or take any notice of it.

That other Refutation, which he allows to be *very Probable*, is this.

Suppose

Suppose $AD = 2$.

And therefore $DV = 1$.

$AV = 3$.

$AS = \sqrt{2}$.

SV , or $YD = 3 - \sqrt{2}$.

The Cube of AD is $= 8$.

The Cube of $DY = 45 - \sqrt{1682} = \text{almost } 4$.

For $45 - \sqrt{1681} = 4$.

DY therefore is somewhat lesse than the Greater of the two Mean-Propportionals between AD and DV .

For Answer to this Demonstration, he thinks fit to examine, whether $45 - \sqrt{1682}$ be indeed equal to the Cube of DY , or $3 - \sqrt{2}$. And he attempts two Methods to satisfy himself.

He proceeds first upon this Supposition; That if $3 - \sqrt{2}$ be multiplied into it self; and that product multiplied again by $3 - \sqrt{2}$; this later Product will be equal to the Cube of $3 - \sqrt{2}$. And, with much labour, and manifold Reductions of Surd Numbers, and the Application of some intricate Rules, he doth at length accomplish that work; and finds, that $45 - \sqrt{1682}$, is indeed, according to that Method, equal to the Cube of $3 - \sqrt{2}$.

$$\begin{array}{r}
 3 - \sqrt{2} \\
 3 - \sqrt{2} \\
 \hline
 9 - 3\sqrt{2} \\
 - 3\sqrt{2} + 2 \\
 \hline
 11 - 6\sqrt{2} \\
 3 - \sqrt{2} \\
 \hline
 33 - 18\sqrt{2} \\
 - 11\sqrt{2} + 12 \\
 \hline
 45 - 29\sqrt{2} \\
 \text{or } 45 - \sqrt{1682}.
 \end{array}$$

I shall not trouble you with an account of his intricate pro-
 cesses in that inquiry; because
 you may see it in himself: but
 onely shew you, in the operati-
 on annexed, with how much
 ease that might have been dis-
 patched, of which he makes so
 much ado.

But a Single Inquiry doth not satisfy his curiosity, and
 therefore he attempts a second Method of finding the Cube
 of $3 - \sqrt{2}$: Upon a Supposition, That the Cube of $3 - \sqrt{2}$,

is equal to the *Cube of 3*, together with 3 times 3 into the *square of $\sqrt{2}$* : wanting 3 *Squares of 3*, into $\sqrt{2}$, and, the *Cube of $\sqrt{2}$* . Which had he pursued aright, would have given the same account with that of his former Inquiry: as by the Operation annexed may appear.

The Cube of 3 is	$= +27$
3 times 3, into the Square of $-\sqrt{2}$.	$= +18$
3 Squares of 3, into $-\sqrt{2}$	$= -27\sqrt{2}$
The Cube of $-\sqrt{2}$	$= -2\sqrt{2}$
Therefore, the Cube of $3-\sqrt{2}$,	$= 45 - 29\sqrt{2}$ or $45 - \sqrt{1682}$.

But, in the pursuit of this Rule; instead of $2\sqrt{2}$ or $\sqrt{8}$, he tells us, that the *Cube of $\sqrt{2}$* , is *Equal to 2*, (that is, The Cube of $\sqrt{2}$, and the Square of $\sqrt{2}$, are the same.) And, for $27\sqrt{2}$, or $\sqrt{1458}$, he takes its near value in effable Numbers, viz, $+27 - 38\frac{2}{11}$, $38\frac{2}{11}$. And then sums up the value of $+12 - 2$ his Cube, thus found, to be $45 - 40\frac{2}{11}$. $+45 - 40\frac{2}{11}$ Which is *much Lesse*, he tells us, than $45 - \sqrt{1982}$. (He should rather have sayd, 'Tis *much Greater*: for that is almost 5, and this is lesse than 4.)

And, least we might otherwise think it an Errour of Negligence, not of Ignorance; He doth, upon Deliberation p. 37. Choose the Errour, and Reject the Truth; Blaming those who think the *Cube of $\sqrt{q} 2$* , to be equal to $\sqrt{q} 8$.

From hence he doth infer some Observations. First, That His two Computations (though both performed according to the Rules of Algebra) do not agree. Which, abating his Parenthesis, is very True: and, the Reason's plain.

Secondly; That Neither of them agree with his Geometrical Proceffe. Which is True also; and, the cause Evident.

And therefore Thirdly, (but here I am not of his mind) That it is not meet to examine Geometrical Problems by Algebraical, or Arithmetical Calculations.

All that I shall Observe from it, is but this. If Mr. Hobbs did understand the strength of these Confutations, and did yet think fit to publish himself the Authour of that Paper thus confuted, (when he might have concealed it,) and pretend it to be all True: You may Pity his Prudence. If he did not understand it; You must Pity his Mathematicks.

I had thoughts, here, of inserting another Problem of the same Authour; and, performed much after the same rate with this of the Duplication of the Cube. 'Twas, To find two Mean-Proportionals between two Lines given. Which, as being a Noble Attempt, and rarely performed, was lately Presented to His Majesty. But this being immediately confuted by that same Noble Hand, which had, but a little before, Confuted that of his Duplication of the Cube: And, being since Retracted (as I am informed) by the Authour himself, and confessed Erroneous: I shall forbear, at present, to trouble You with It, or its Refutation; till Mr. Hobbs shall think fit to Resume it again, or new Vamp it, as he did his false Quadratures once rejected.

Nor shall I detain You longer in examining his Mathematicks; of which, I suppose, You may already have seen enough to make you Weary. For, though Thomas, upon a like Intimation, tell him, Noe; but *Paradoxia Detector*: Dial. pag. 177. I am apt to think, You will rather have cause to say, as He there, pag, 178. *Paradoxa non sunt; Absurda sunt*. Which yet is easily Answered. For, as he tells us of his Politicks, if we may beleeve him, Lesson. p. 56. That, His Doctrine therein is generally received by All, but those of the Clergy; and, Their Testimonies, he tells us, are Invalide: So, His Geometry (he may tell us as well) is not Refuted by any but Mathematicians: whose Judgement in this case, is not to be credited.

To the rest of this Dialogue, it is but little that I shall say. For, Your-self being concerned in it, You have, I presume

Presume, given Your self a better account of it, than I am like to do.

But here, I think, that first he doth You wrong: Ascribing those Experiments to the *Society at Gresham-Colledge*, which are peculiarly Yours; Being Made and Published by Your self, before that Society had a beginning.

Yet I suppose, he did it not so much either for your Disparagement, or, to Gratifie that Society; as, to Advantage the Reputation which he promised to himself from it; as thinking it a more Noble Victory to have out-done such a Society; than to have the better of a Single Person.

And I am the rather induced to beleieve this, Because I do not find that he hath any Superlative Respect for them: The Designe of that Piece seeming rather to look the other way; So many faults he finds with, the *Name*, the *Number*, the *Persons*, the *Principles*, the *Designs*, and *Experiments* of that Society.

He is not satisfied, pag. 3. with the Name *Society*, but thinks they ought to be called an *Academy*: For, in *France* and *Italy*, he tells us, *such Companies are so called*; and, because Mr. Hobs hath been in *France*, he ought to bring us a Name from thence. Which *Academy*, he defines to be, *Such a Meeting as whereof Mr Hobs was one*; (as that at *Mersennus* his Chamber.) For though this Definition do not at present agree to that Society at *Gresham-Colledge*; Yet it is to be supposed that it Will very suddenly; when they shall have found True, by Experience, what he now tells them, *That they will never be able to make any advance*, what ever study or industry they use, *till they make use of* (Him, or at least) *His Principles*.

Nor doth he think fit pag. 2. that they should confine themselves to some Certain *Number* of men: But, that it should be free, for any that will, to intrude themselves. For, *London* being a publick place, and *Gresham-Colledge*

ham-Colledge standing in *London*, it ought to be free for any man to intrude himself into any Company that meet at *Gresham-Colledge*.

He then thinks fit to give his Judgement, pag. 3. of the *Persons*, which are wont there to meet: That *D* will tell stories enough, if you will believe him; *H, I, K*, are *Algebrists*, and therefore ought to be excluded, (because, 'tis fit that every one that will, should be admitted;) That *E, F, G* serve to make up a *Number*; &c. Only, there is one *C*, which is an *Honest, Subtile, Ingenious Person*, and a *Known* to Mr. Hobs. And pag. 16, That There is no Difference, between Them and a professed *Mechanick*, but this, That the *Mechanick* is rather to be preferred.

Their Pretenses, he would have it thought p. 2. are such as His are wont to be; viz. That the Knowledge of nature, to the great Advantage of this Nation, and of all Mankind, must either be Advanced by Them, or that we must for ever Despair that it will be done by Any. But herein, I think he doth mistake them. 'Tis true indeed, That Mr Hobs doth often thus pretend, or what is tant-amount; And therefore thought it fit that His Doctrine should be made the Standard for Schools and Pulpits: And, Less. p. 56, 57, that, if he should not recommend it for such, he had written it to no purpose. Nor is it Vaunting, to desire, that by entire Sovereignty it be Imposed upon the Universities, &c. but, a Necessary part of the Business he took in hand. And Dial. pag. 180. He believes, That Never Any will be able to give a better account of the Effects of Nature, than He hath done. And therefore adviseth Thomas (Dial. Phys. p. 32,) to rest contented with *Physica Hobbiana*, and to Live by his *Ethicks*: For, all that the Charge and Furniture of other men can amount to, is onely an Attempt, he tells us pag. 23. *Eatenus tantum prodire quantum antea prodierat Hobbius*. But, that any such have been the Pretensions of those at *Gresham-College*; as That none shall ever be able to adde to what They shall do: I have not yet heard. For though Mr Hobs would

K 3

have

have it thought, pag. 1. that *they have taken up their Principles from him*; yet surely, not All his Principles; nor this, in particular, Thus to Pretend. For, though there are in that Society, many Noble, and very Excellent Persons; Yet I do not think, that the Estimate of their Worth, is to be made by what onely is done at those Meetings; (so small a Portion of their Employment:) Much lesse are we to think them guilty of so much Vanity, as Mr *Hobs* would, very unhandsonely, insinuate.

But their *Successe*, he thinks, will be far short of what he would insinuate to be their Pretense: and doth expect (for, so much he there intimates,) that *Themselves will be Despised, and, Philosophy for their sakes*. For though in his *Epistle to Sorberius*, he would seem to promise this Meeting some good succeſſe, that *dubitandum non sit quin Conventus hic promovendis Scientiis plurimum sit profuturus*; yet that Promise is there suspended upon Condition, That *they will proceed upon his Principles*; otherwise, (he hath read their Destiny,) they must never expect to do any good, what ever their Study, Pains, or Experiments may be: *Nam Convenient, Studia conferant, Experimenta faciant quantum volunt; nisi & Principiis utantur meis, nihil proficient*. And pag. 8. he tells us, That, *without admitting his Hypothesis, It is Impossible, but that all their Cost, their Skill, and Labour will come to nothing*. And, positively, p. 5. That He Despairs of any Fruit from this Meeting.

Their Principles, which he sometimes intimates, they Have Borrowed from him; as pag. 1. Sometimes, that they Should have done it, and Ought to do yet, or else they must despair of succeſſe; as in his *Epistle, Preface*, and p. 8. 23. & *alibi*. are especially those two; Concerning *Motion*, and, concerning his *Simple Circular Motion*. First therefore he would have it thought, That He was the Inventer of this Notion, That *Sension, and other Effects of Nature are performed by Motion*; To prove which, he, twice at least, (*Epist. and pag. 23.*) cites, out of *Aristotle, Ignoto Motu,*

ignorari

ignorari Naturam. His other Invention, of *Simple Circular Motion*, he tells us, pag. 9. is the same with that of the Earths Annual Motion, introduced by the Copernican Hypothesis. And therefore Mr Hobs must needs be the first Inventer of Both.

The Knowledge of Nature, or Causes Natural, he would not have them look to find in *Libris Magistrorum* (Præfat.) But, in *Libris Hobbi*, those Causes may be found, than which (he told us, in his former Dialogues, p. 180.) he doth not believe that better will ever be found by any.

He would have them take heed of meddling with those things *quæ capi non possunt*, (for he thinks fit to prescribe the Subject, as well as the Method of their Inquiries :) as Rarefaction & Condensation (for these are things *quæ intelligi non possunt*;) and, Immaterial Substances, most of all, (for fear least it should be thought, There is a God, or Souls Immortal.)

Their way of Experimental Inquiry, he doth not like. For, though in his former Dialogues, pag. 180, he doth acknowledge, That the History of Nature is hereby Inriched; without which the Knowledge of Nature is but in vain expected: And here, pag. 2. That we are not easily to take upon trust what is related in Story: Yet 'tis, he saith, pag. 2, 23. &c. to no purpose to make these New Experiments, (whether to Furnish themselves with New Phenomena, or to satisfy themselves of the Truth and Certainty of what is related by others;) For, first, unlesse All be present at every New Experiment, Some of them must either Believe the rest, or still remain in Doubt: Next, Because there is every day more to be seen Abroad, (in Heaven, on Earth; by Land, by Sea,) than the Few Experiments which they can make in a Private Room; But most especially, Because, after all their Pains, their Cost and Charges, the uttermost of what they can hope for, is but, To find out, what Mr Hobs hath found out already.

Beside these general Animadversions on that Meeting, and

H O B B I O S

What they do; and, his Prognostication of the Event: He thinks fit in particular to apply himself, as he pretends, to the *Experiments made at Gresham-Colledge, by that Society*; Meaning indeed, those made by Your self (at Oxford and else-where) and Published by You in that Excellent Piece which You call *Experiments Physico-Mechanical, touching the Air*; written by way of Letter, to that Noble Lord, Your Nephew, the Lord Vicount of *Dungarvan*, Eldest Son to the present Earl of *Cork*, Your brother. For though that Piece were published long before the Meeting of this Society; yet (because himself is so good at Prognosticks) he might think You wrote it only by way of *Prognostication* of what was after to be done by a Meeting, which was not then thought of.

Now, that he might not want an Adversary; He is pleased to Suppose the Author of those Experiments to *Maintain*, whatever Mr *Hobs* hath a mind to *Oppose*. And he begins with that of *Vacuum*.

I do not remember, that You have therein any where declared Your Opinion, Whether there Be, or Be not, a *Vacuum*. But onely related matter of Fact, as it appeared upon Your Experiments, without inferring from it either the Affirmative or the Negative in that Question. That much of that which We call *Air*, is *Drawn out* of the Recipient, or the Recipient (in a great Measure) *Empried* of it; it's very like You may somewhere Affirm, (and, I think, Mr *Hobs* doth not Deny:) But whether or no some *Homogeneous Aether*, as Mr *Hobs* would have it, do succeed in the place of that *Heterogeneous Mixture* which we call *Air*, such as that is wherein we *Breathe*; because You have not thought fit to deliver an Opinion, Mr *Hobs* thinks fit to determine for You what Your Opinion shall be. And, because He is of Opinion, *There is not a Vacuum*; He will therefore have it Your Opinion, pag. 4, &c. That *here is*. In order to the Confutation of which, there is amongst other his *Postulata*, this Necessary One (which he

he hath oft occasion to have recourse unto,) *Suppono, Un-*
versum mundum esse Plenum, p. 12, 24, 25, &c. And from
hence, he doth very strongly infer, *Ergo, Non datur Vacuum.*
ὅμη ἐδὲ δ' ὁ ζῆαι.

In like manner he deals with You touching the Nature
of *Fluids*. It's possible that You may have somewhere
intimated, That in divers of those things, which, as to
Sense, appear *Fluid*, and *Homogeneous*, there are a multi-
tude of *Heterogeneous* particles not *Fluid*. (For it is like
You have sometimes seen a Thousand little Moats dance
in the Sun-beams ; which, when the Room is all equally,
either Light or Dark, no Sense can take notice of, but
deems the whole, for ought appears, to be Fluid and Ho-
mogeneous.) But, whether there be or be not in Nature
a Body properly Fluid and Homogeneous, whose every
smallest particle is, like the Whole, Fluid and Homoge-
neous ; Because You have not (so far as I remember)
yet declared Your Thoughts ; He thinks it fit (being
good at other *Divinations* as well as at *Prognosticks*) to
tell You What they are. And, because it is His Opinion,
That *there is a Body thus Fluid* ; He will have it Your
Opinion (that he may have somewhat to dispute against)
That *there is not* : And, That the onely thing which
distinguisheth the *Fluid* from *Non-Fluid*, is the *Smallness*
of those particles whereof it doth consist, pag. 5. &c.
For Confutation of which, You are to allow him this
Postulatum, pag. 4. *Suppono, Aerem Fluidum*, i. e. *facile*
divisibilem, in partes semper Fluidas, semperque Aerem.
From whence it follows, very naturally, That
there is a Fluid Body. Quod erat Demonstrandum.

And if You shall be so Unreasonable as not to allow him
these *Postulata* ; *Desperare facis omnem Conventus vestri*
fructum. pag. 5.

Again ; When You intimate, That there may be in
this Common Air wherein we breath, many smal Particles,
which, like so many small Haires in a Lock of Woo!

H O B B E S

Crushed by strength, or some incumbent Weight, into a Narrower Space, will, upon the Removal of that Pressure, Dilate or Expand themselves into a Larger Room; upon a like principle as that of a Spring, or a Bended Bow, returning to its former posture when the force that bent it ceaseth. First, He doth not allow any man to believe, that there is in nature any such thing as a *Spring*, or *Motion of Restitution*, who doth not imbrace his *Hypothesis*. pag. 8. And, then, By *Air*, he would have to be understood, *Aerem ab omni terra aqua q̄, effluvis purum, qualis putatur esse Aether*; pag. 4, 6, 25. &c. (You need not be solicitous about the *Syntax*; for Mr *Hobs* studies *Elegancies*, not, *True Latine*.) For Mr *Hobs* is very dexterous, in Confuting others, by putting a new Sense upon their Words, rehearsed by himself; different from what the same Words signifie with other men. And therefore, if You shall have occasion to speak of *Chalk*; He'll tell You that by *Chalk*, he means *Cheese*: and then, if he can prove that what You say of *Chalk*, is not true of *Cheese*; he reckons himself to have gotten a great Victory. And in like manner; When that *Heterogeneous Mixture* (whatever it be) wherein we breath, is commonly known by the name of *Air*; and this *Air*, wherein we live, abounds, You say, with parts of such a nature: He tells You, that, by *Air*, he understands such an *Aether* as is among the Stars; And, that, in this *Air*, there be no such Particles, is proved by that *Postulatum* we last mentioned; *Suppono, Aerem fluidum*, &c.

Beside these goodly Confutations, He hath one great Engine, which he calls his *Simple Circular Motion*, with which he hopes to salve all the *Phaenomena* in Nature. Which, by his Description of it, *Corp. Cap. 21*. I take to be such as that of the Good-Womans *Hand* that turns the Wheel when she Spins; Or, the Chandlers hand which turns the Quern when he makes Mustard: Where every *Line*, in the Hand or Body thus moved, is supposed to retain a *Position*, still Parallel to it self. Such as that of the
Earths

Earths Annual Motion, according to the *Copernican Hypothesis*.

But 6 *Dial.* p. 179. He thinks the Reason why his Hypothesis is not received, is, *Because very few Men, he fears, are able to Apprehend such a Motion.* For (Mr Hobs being the first that ever taught his Grandame to Spin) *never was there any man, he saith, before him, that took notice of any such Motion.* (For, though he tell us, in the same page, that *Copernicus ascribes the same Motion to the whole Body of the Earth*; Yet Mr Hobs his Book, *De Corpore*, You ought to know, was written long before the *Copernican Hypothesis* was thought upon.) To help therefore the Fausie of such as are not able to Apprehend this Motion, he doth, in that and the following page, spend some time to give a Second Description of it.

And then (because he doth not yet find his Doctrine to passe currantly,) He doth, a Third time, in his *Dialogus Physicus*, p. 9, 10. give yet a further Description. For he doth not doubt, pag. 8. but that, *if it were Understood*, it would be Received.

The Result of that Description amounts to this; That, by his *Simple Circular Motion*, he means, *such a Motion* as is neither *Circular*, nor *Simple*. For he doth not mean that of *Conversion*, or *Circumvolution*; as when a *Plain* moves round upon *one Center*, or a *Solid* upon *one Axis*, (Which You, perhaps, would have thought the most *Simple* of all *Circular Motions*;) But such a Motion, as wherein *no Two Points* are moved upon the *same Center*; nor, any *Two Lines* (such *Two* I mean, as are not parts of the same *Streight-line*,) upon the *same Axis*: but *so many Circles*, he saith, *there are, upon so many several Centers, as there are Points in the Whole.* *Dial. Phys.* p. 10. Nor doth he mean, That those *Points*, by this *Circular Motion* do describe *Circles*; but (*motum in se redeuntem quemlibet*) any *Figure* whatever whereby they may return again to a place where once they were. *ibidem*. (Than which, he saith, *there is nothing*

more easie to be Apprehended.) Which Motion is indeed a kind of *Vertigo*, and may, for distinction sake, be called *Hobbiana*; but, why it should be called *Simple Circular*, I see no reason at all, save onely, because it pleaseth Mr *Hobs* to give it that Name.

And this *Simple Circular Motion*; (which, though nothing, he saith, be more *Easie to be apprehended*, yet so *Few*, he tells us, are able to Apprehend;) He attributes to all, the Smallest, *Particles of Earth and Water* wherever. And, for Proof of it, He doth Suppose, That thus it is, and thus it Ever was, and that 'tis *Natural*; and in this *Eternal Cause*, he tells *Thomas*, he ought to Acquiesce. *Dial. Phys.* p. 7, 10. &c. And therefore it is not fit for You or Me to inquire further into the reason of it.

I shall not trouble You with a Particular Account, how he doth apply this Universal Engine to produce the several Effects of Nature; Or, with any Confutation of it.

For, (beside what concerns Your self, which how weak it is, I need not tell You;) the rest is little else than a Repetition, out of his Book *De Corpore*, of what D. W. hath Refuted long since. And, though Mr *Hobs* have thought fit to Repeat it, first in his Former *Dialogues*, p. 179. &c. and now again in this *Dialogus Physicus*; (and, how oft he means to Repeat it again hereafter, who can tell?) It will not be therefore necessary to repeat the Refutation, so oft as he repeats his Errours.

Onely I cannot but observe, in the general, a great Resemblance between this his *Physical Hypothesis*, and, his *Geometrical Constructions*: For as, in these, he draws a Multitude of Lines whereof there is no Use made, as to the Construction or Demonstration of his Problem; (as You say but now, in his *Duplication of the Cube*;) So, much of his *Hypothesis* is to no purpose, as to the Effects of Nature. For whereas the main part of his *Hypothesis* seems to be placed in this, That the Motion is of *such a Kind*; (*viz.*

a *Simple Circular*, wherein each *Line* is still to preserve a *Parallel Position*;) In all his *Applications* of his Engine in this *Dialogue*, I do not find that the *Parallelism*, which this Motion is to preserve, hath any influence at all upon the Salving of those *Phænomena*; but, that the Work proceeds evere whit as well, which ever end go forward. For, the Immediate Effect thereof being no more but this, that they Knock and Juttle one another; any confused Motion whatsoever, might as well have served his turn for this purpose, as the *Simple Circular*; (and therefore that part of his *Hypothesis*, which supposeth the preserving of this Parallel Position, and his *Specification* of the Motion to that end, are to no purpose.) Nor is it lesse usual in a game at *Bowls* to see the *Bowls* in a Volutation Knock one another out of place, (where no such parallel position of every line is preserved;) than, at *Shovel-board*, to see one Piece knock off another, though this (as Mr *Hobs* calls it) be a *Simple Motion*, but not *Circular*. And, what he would seem to make the Reason of his Arbitrary choice of this Kind of Motion, pag. 9. That a *Simple Circular* doth produce a *Simple Circular*: How far it is from being *Universally True*, is evident from the first Instances that we gave of it. For, though the *Hand* that turns the *Wheel* or *Quern* have this *Simple Circular Motion*; Yet, who knows not that the Motion of the *Wheel* or *Quern*, turned by it, is a *Circumvolution* on a single *Axis*. Nor is it at all *Peculiar* to this Kind of Motion, to produce a Motion Like to it self; but every way as common to other Motions. As is Evident in the *Wheels* of a *Watch*, where each by a *Circumvolution* on its own *Axis*, communicates to the next the *Same Kind* of Motion: Which may indeed, as properly, be called a *Simple Circular*; but, is not that *Vertigo Hobbiana* which we be now speaking of.

The Result therefore of his *Natural Philosophy*, (For instead of a *Confutation*, I shall onely give You a short *Synopsis* of his *Postulata*, with his *Inferences* from them,) amounts to thus much.

First.

First, He doth Suppose, That *All is Full*: From whence he is to *Infer*, Therefore there is no *Vacuum*.

Secondly, He doth Suppose, That the *Air is perfectly Fluid*: In order to Prove, Therefore there is somewhat *Fluid in Nature*.

Thirdly, He doth Suppose, That the *Air is perfectly Homogeneous*: To Prove, That it is not full of *Heterogeneous Particles*.

Fourthly, He doth Suppose, That all *Earthy Particles are in continual Motion*: To the End, that they may *Knock one another*.

Fifthly, He doth Suppose, That this *Motion is Simple Circular*: To No purpose.

Sixthly, He doth Suppose, That thus it *Ever was*: And Therefore we ought not to *inquire the Cause of it*.

Seventhly, He doth Suppose, That his *Supposition is a sufficient Proof*: Else we have none at all.

Lastly, He doth Suppose, That *what he Affirms is well Demonstrated*: And Therefore, *What ever can be said against it, is not Refutatio, but Refutatum*.

You may *Think* perhaps, That, if any Other will please to *Suppose* the Contrary; This *Refutation* will be as *Cogent* as his *Demonstration*. If so; because I ought to be *Civil* to a Person whom I Honour, I will not take upon me to confute those *Thoughts*.

I have but one Remark more with which I mean to trouble You, before I dismiss this Dialogue, as I have done the rest. And it is, concerning the Authors Ingenuity therein towards Your self. For whereas, If those *Experiments* whereof You give an *Historical Narration*, (without any Reflexion on him at all, so far as I remember, or so much as Mentioning, much lesse Disparaging his Hypothesis,) do indeed so directly conduce, as he pretends all along, to the Establishing of his Doctrine; (*quasi Nature quodam Consilio ad Physicam suam Confirmandam oblata*;) You might have expected a return of *Thanks*, for Your
Cost

Cost and Pains in a Work so subservient to His Design; and, for Your Favour in Communicating those Costly Experiments; for him, as freely as any other, to make use of: Yet, Because, unhappily, (as if You had thought it lawfull to be Civil to some Other Persons,) You have let fall some Words of Commendation or Respect, for some few Persons whom You had occasion to mention; He thinks himself concerned, instead of Thanks, to *Write a Book against You*.

But while I am Writing this last Passage, I may seem to have forgotten the Business I was about, and to which I am to return again: Which is, to bespeak Your *Favour*, not, to *Aggravate* any thing against the Author of that Piece. In order to which, I have made that seeming Digression, to take a View as well of This, as of his Other Six Dialogues. From whence if You think I may Infer, either that You *May Neglect* safely, or, *Ought to Pity*, the Author of those Dialogues; I have not then lost my labour: But, if You shall grant, that I may infer *Both*; I have then done my Work. For I shall not then doubt, but that You will either *Spare* him altogether, or at least Use him more *Mercyfully* than He deserves.

And, truly, there is one Argument yet behind, which I did not foresee at first, but doth suggest it self upon the View of what I have written. When I look over what I have been Pleading in his behalf; my Apology it self, I doubt You will say, is Sharp enough. And, though I have often checked my Pen, and spoil'd an Argument more than once (as You can witness) which would, if pressed home, seem too Severe: Yet, I must confesse, He lies so open to the lash at every turn, that

Difficile est, Satyram non scribere.——

Nor is it, almost, possible, the Matter being as it is, to give any tolerable Account of what he Writes, but that a bare Narrative, be the Words never so Mild, will be Severe

end

enough. And, saying that You are a Person extremely Civil, it will be hard for You to Touch, almost any where, the Parts are so Tender, but that the Blood will follow.

And, having said thus much, I shall not trouble You farther with any more: But leave it to Your own Thoughts, whether You will Judge it necessary for You to say any thing at all: Especially, if You shall think, That I have already said too much. Yet, if, instead of *Answering Mr Hobs* You shall think fit, to give the World a further Account of Your Thoughts; for the *Improvement* of those Noble Experiments, whereof You have already given us the *History*: You may thereby, Gratifie a Multitude of Worthy Persons who Honour You; and shall not more Oblige any, than

SIR,

Oxon. Febr. 20.

1661.

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Your Honours

Very Humble servant,

JOHN WALLIS.



